JULY 1956

Power Engineering

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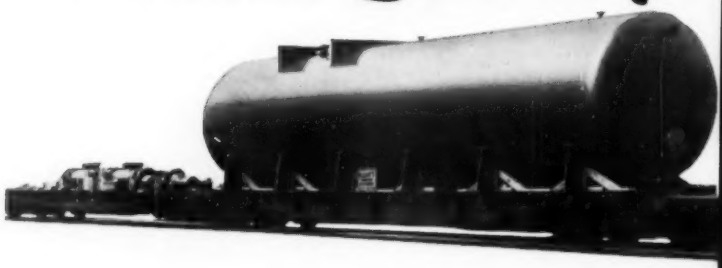
We don't kiss them goodbye



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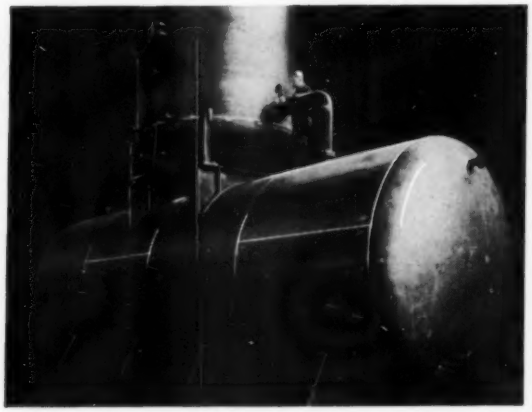
You get a complete Elliott job when you order an Elliott Deaerating Heater!

Elliott staff engineers do the design work, operating in a tradition set by forty years of Elliott deaeration progress and experience.

Construction starts on a large deaerating heater. All construction work is done in the large, well-equipped Elliott, Jeannette, Pa. plant.

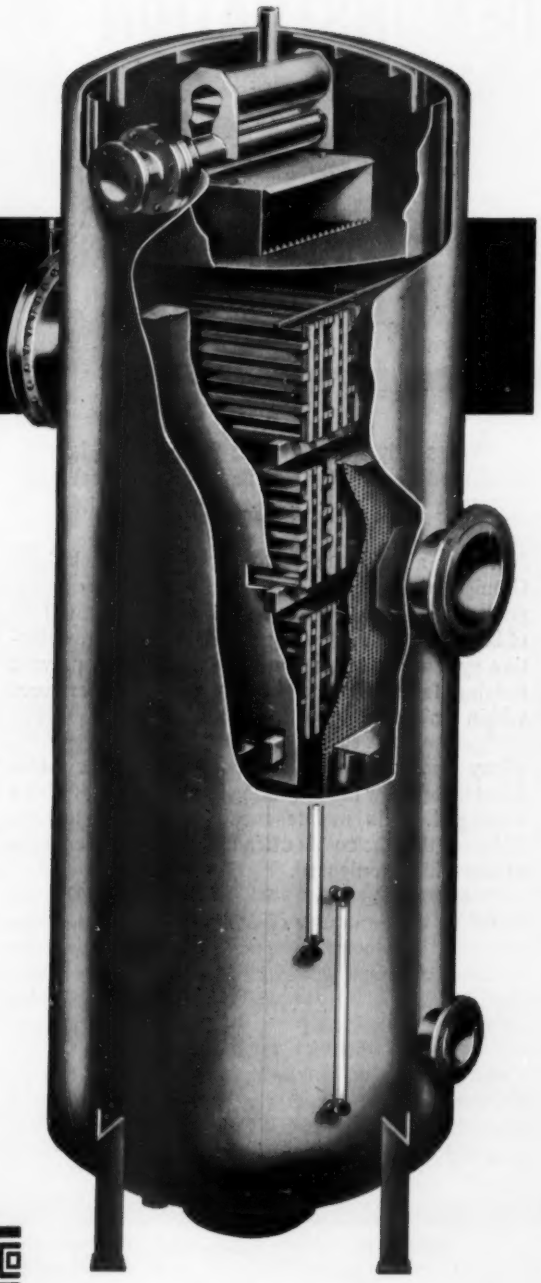
The Elliott welding shop where the "big ones" are built. Construction is in accordance with rigid ASME code requirements.

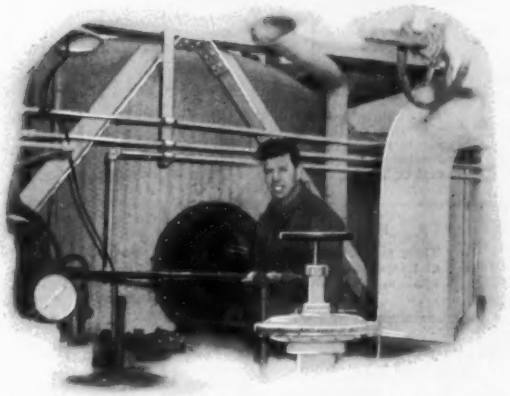


Elliott maintains complete facilities for hydrostatic testing. Every Elliott deaerating heater receives an "ok" here prior to shipment.

on the freight siding!

..are backed by field service attention throughout installation, start-up and operating life.





Elliott engineer inspects deaerating heater installation during periodic plant shutdown.

Elliott deaerating heaters are not only designed and fabricated in the Elliott Company headquarters plant, but are backed by Elliott factory-trained field engineers who are available for consultation on pre-installation questions, and for help on start-up and maintenance throughout the life of the equipment. For complete information on Elliott deaerating heaters, write Elliott Company, Jeannette, Pa.

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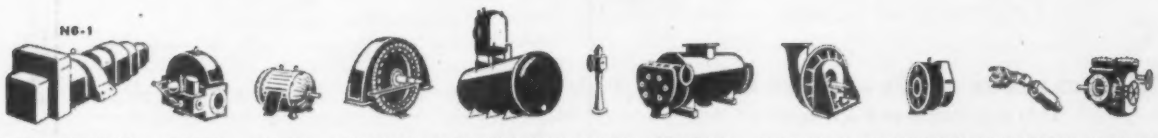

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Thomas A. Edison Inc.'s

PERSONAL DEMONSTRATION

shows how you can

INCREASE PLANT PRODUCTION

Our representatives throughout the nation are ready to demonstrate *a complete* Omniguard system right at your plant or office.

Takes Only a Few Minutes to Prove Simple Omniguard System Protects Bearings and Processes; Cuts Down Time; Increases Equipment Life

Just take a few minutes to prove to yourself how Omniguard can make it possible for you to operate your equipment at peak production rates without fear of breakdowns . . . how this simple temperature detection system gives you ample opportunity to prevent bearing failures or to keep process temperatures within limits.

RECORDS REVEAL FAILURES COSTLY

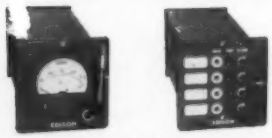
Many operators—after a record check—are astonished to find how much bearing breakdowns have been costing them in maintenance and lost production. They see that the cost is often many times the expense of installing Omniguard.

COMPLETE 4-POINT SYSTEM FOR LESS THAN $500

Consider the thousands of dollars involved in equipment and production output. Contrast this with the fact that one Omniguard unit costs less than $500. And because of its simplicity, installation costs are also low.

SIMPLE, DEPENDABLE

Omniguard has no electronic or moving parts. It is the most dependable system available today. Modular in design, each unit gives you four-point detection. You can add as many as you need . . . as you need them.



The modular indicator and monitor, with their mounting brackets, and the resistance temperature detectors, are all you need for a continuous operating analysis of remote process or bearing temperatures.

Resistance Temperature Detectors

These are just four of the many different types of temperature detectors produced for varied applications of the Omniguard system.

The 242P for high temperatures (to 1300°F.)

The 166NC with pre-loaded sensitive tip specially designed for bearing protection.

The 230N for general purpose industrial use (stem-sensitive).

The 235N90-35 for fast response in corrosive service.

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Combustion Engineering, Inc.
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Eastman Kodak Co.
Esso Standard Oil Co.
Florida Power & Light Co.
General Electric Co.
Hercules Chemical Co., Inc.
I-T-E Circuit Breaker Co.
North American Aviation, Inc.
Public Service Electric & Gas Co.
Republic Steel Corporation
Sun Oil Company
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DEARBORN 2-5446

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Subscription Information: Published monthly; price in the United States and its possessions $10, in Canada $11, other countries $12 per year; single copies $1.

Indexed in the Industrial Arts Index and the Engineering Index on file in public and many private libraries.

Microfilm edition: Request prices from University Microfilms, Inc. Ann Arbor, Mich. All volumes since 1948

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NBP BPA

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ENGINEERS' PREVIEW

TO KEEP from blowing its fuse this summer as perspiring citizens switch-on air conditioners and refrigeration units, one big Midwest utility has installed thermostats on its power poles.

Purpose of this unusual application is not to heat — or cool — the outdoors, but to get advance tip-offs on temperature changes so the power company can better cope with the increased electrical demand. According to officials at Kansas City (Mo.) Power and Light, July and August are now the months of heaviest electrical demand (it used to be the winter, especially around Christmas). Air conditioners combine with refrigerators, freezers, dehumidifiers, fans and other anti-heat devices to boost electrical loads. In turn, this tends to cause a voltage drop in the system unless compensated for.

Generally this demand is met by switching on more transformer capacity — but the trick has been to determine precisely when to do this. Time clocks and other control devices proved unsatisfactory because they couldn't differentiate between hot and cold days.

The problem was solved by installing an industrial version of Minneapolis-Honeywell's household thermostat on the power poles. As the temperature rises, say to 75 or 80 deg, the thermostat automatically switches in more transformer capacity to meet the extra load demands. Conversely, as the temperature drops, it cuts out the extra capacity. It's as simple as that!

PROPOSAL for Government fellowships for engineering and science graduates has been made to a Congressional Subcommittee by Cherry L. Emerson, former vice-president of Georgia Tech, on behalf of the National Society of Professional Engineers. These graduates would obligate themselves for a period of three years to teach general science and math courses in high schools. Their salaries would be supplemented by the Government beyond the amount normally paid high school teachers. At the end of three years, they would be eligible to a fellowship which would enable them to attend the institution of their choice for three years and obtain a Ph. D. in their field of specialization. Mr. Emerson has suggested that the program be administered by the National Science Foundation.

ONE OF the world's largest installations of gas turbines for the generation of electric power will be placed in operation in 1957 at Victoria, B.C., Canada.

The British Power Commission has ordered four gas turbine-generator units with a total power capacity of more than 75,000 kw from General Electric Co. They will be installed in a power station in the city of Alberni, located on the east side of Vancouver Island.

Order includes two 19,750-kw simple-cycle, single-shaft units, and two 18,000-kw regenerative-cycle, single-shaft turbines. Each gas turbine will drive a 3600-rpm, 3-phase, 60-cycle, hydrogen-cooled generator for 13,800 v, 60 cycles.

THAT BURNING question — what to get for the person who "has everything" — is being answered by the Norma Pencil Corp., which, next month, will market what it believes is the most expensive practical writing instrument ever produced — a platinum "Multikolor" mechanical pencil that will retail for about $500. Norma also has in production a $250 palladium pencil.

TWO 450,000-kw coal-burning steam-electric generating units, the largest ever undertaken in the history of the electric power industry, will be built on the American Gas and Electric System. Locations of the units, however, have not yet been determined.

The capacity of these units is made possible by the growing size of the

System and the ability of the System's 330,000-v transmission network to supply the necessary back-up power from other major generating sources whenever one of these large units must be shut down for periodical maintenance.

Each unit will consist of a 450,000-kw machine receiving steam at 3500 psi and 1050 F. The high-pressure turbine element will operate at 3600 rpm, the low pressure element at 1800 rpm. The 3600-rpm generators will be liquid and hydrogen cooled. The steam cycle will use double reheat to 1050 F. It is calculated that the thermal efficiency of these units will be close to 41 per cent.

Commenting on the significance of the new units from the point of view of atomic power, Philip Sporn, American Gas and Electric Company president, points out that the decision to go ahead with these super-size, super-pressured coal-fired units is not due to any pessimism on their part over the ultimate feasibility of atomic power. On the other hand, he says, the new 450,000-kw units actually should make a major contribution to the economics of atomic power when the reactor development has progressed sufficiently to become feasible, for it appears obvious that very large units will permit best advantage to be taken of nuclear-generated heat.

FIRST MAGNETIC slip couplings to provide adjustable speed for high-pressure boiler feed pumps operating above 3600 rpm will be installed by South Carolina Electric & Gas Co. at its new Silas G. McMeekin Station near Irmo, South Carolina. For Unit No. 1, three 2500-hp, 1800-rpm magnetic drives have been ordered from Electric Machinery Mfg. Co., to drive 5000-rpm, 2793-psi pumps through 1:3.05 step-up gears.

In addition to the three magnetic drives for the feed pumps, Electric Machinery will also build two adjustable-speed magnetic drives for induced-draft fans and two for forced-draft fans for the No. 1 generating unit.

BACKLOG of steam turbine-generator unit orders totaling more than 19,000,000 kw in capacity and scheduled for shipment as far ahead as 1959 was revealed recently by General Electric Co.

W. E. Saupe, department general manager, stated that the utilities have found that the increasing demand for electricity over the past several years will not level off, but will increase even faster as more and more electrical appliances are introduced in homes, and as factories purchase electrically operated production equipment.

Consequently, the utilities have planned their expansion programs over the next three years and have placed their orders for steam turbine-generator units to insure delivery and installation in time to meet the expected demands.

While 47 units of 5,200,000 total kilowatt capacity will be shipped this year, Saupe pointed out that the department will experience its greatest year in production in 1957 when some 71 power-makers with a combined 7,900,000 kw capacity will be manufactured.

AT THE ASHTABULA power plant of the Cleveland Electric Illuminating Co., a 250,000-kw turbine-generator will be installed, more than doubling the plant's present capacity. It will be housed in an addition to be built at the east end of the plant, which now contains four 60,000-kw generators. Ground will be broken for the structural work late this year at the 117-acre plant site. Construction of the generator itself will begin within the next few weeks. The installation, involving a total expenditure of approximately $37,000,000 will be completed by the close of 1959.

FOUR of the larger electric utility companies supplying 90 per cent of the power for Connecticut are now working out a plan to develop their bulk power supply to provide the State with "a high standard of electric service at low cost," the Summer and Pacific General Meeting of the AIEE was told.

While each of the companies "is a separate, corporate entity, conscious of its independence, yet searching for high economy," their "one system" plan provides a basis where they "will jointly benefit from the economics of generating units of larger sizes than could be justified on an individual system basis," three engineers reported in a paper titled The Connecticut Capacity Coordinating Plan. The authors were C. E. Brown, of the Hartford Electric Light Co., C. T. Hughes, of Connecticut Light & Power Co., Berlin, Conn., and R. G. Warner, of United Illuminating Co., New Haven.

"Beginning in 1957," they said, "the capacity of each new steam generating unit will be allocated to the system of the four companies to the extent necessary to provide each system with the same percentage reserve over its peak load. The energy produced and the actual annual costs of these units will be shared in the same ratio."

The fourth participating company is the Connecticut Power Co.

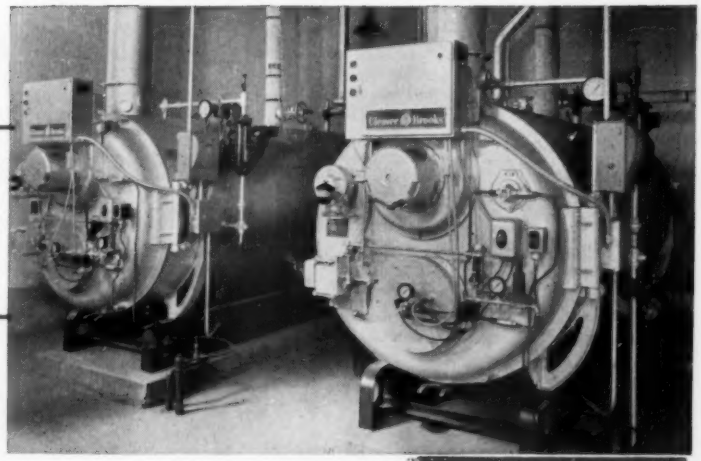
TO SUPPLY the increasing power demands of the Rio Grande Valley, El Paso Electric Co. has authorized Stone & Webster Engineering Corp. to proceed with the construction of Unit No. 6 at the Rio Grande Station. The unit will consist of one 44,000-kw preferred standard turbine generator which will be supplied with steam at 850 psig, 900 F from a gas or oil fired steam generator capable of producing 470,000 lb of steam per hour. Cooling water towers will be required and, in turn, will be supplied with water from deep wells.

WOULD YOU LIKE TEAR SHEETS?

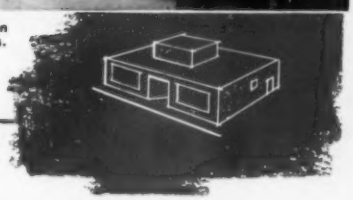
Readers wanting tear sheets of any article appearing in the issue for their personal file may obtain them by indicating the item desired on one of the post cards appearing in this issue—Editors.

18 sizes
110 models
15 to 600 hp

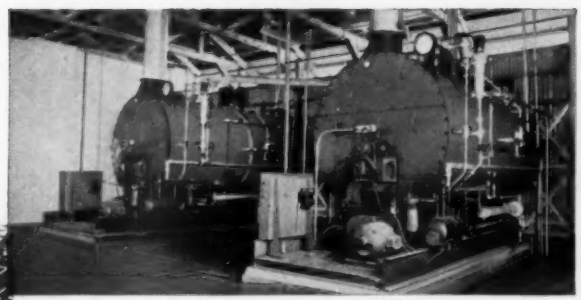
yours from Cleaver-Brooks



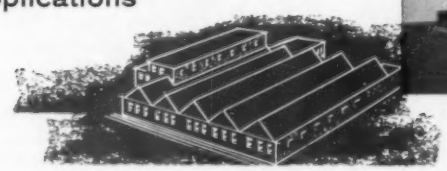
CB SERIES — The ultimate in compact, quiet-running boilers. Sizes: 15 to 150 hp.



the broadest line of cost-saving "packaged" boilers—for hundreds of applications



LR SERIES — Standard of the industry for hot water or steam service, for heating or processing. Sizes: 200 to 600 hp.



THE two installations above are representative of Cleaver-Brooks' broad range of standard models. The wide choice makes planning and selection of a boiler for your specific needs — large or small — a simple, time-saving procedure.

Your nearby Cleaver-Brooks representative, with years of specialized boiler experience, can be of real service to you. Working with you and your engineers, he can help you to find ready answers to questions of size, loads, present and future steam or hot water needs, space and equipment arrangement. Where local conditions dictate, oil, gas or combination oil/gas firing can be selected for greatest savings. And once installation is completed, arrangements are made for factory-supervised starting and training your operator.

Keep in mind, too, the many fuel and maintenance-saving advantages of four-pass design with forced draft . . . the standard equipment electronic combustion controls which assure continuous, safe operation.

Cleaver-Brooks boiler owners enjoy all these advantages and share in the combined application engineering experience of more than 19,000 individual boiler installations. Put this experience to work for you. Cleaver-Brooks Company, Dept. H, 311 E. Keefe Ave., Milwaukee 12, Wis., U.S.A., Cable Address: CEEBEEWEST — all codes.

See the classified pages of your phone directory for name of nearest representative. Send us your name to receive regular issues of the new Cleaver-Brooks Bulletin, or write for newest literature.

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TWENTY-FIVE YEARS OF LEADERSHIP
BY THE ORIGINATORS OF THE SELF-CONTAINED BOILER

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WHAT THEY TELL US

IN HIS HOSPITAL POWER PLANT (*see April issue, page 6*), L. A. Border said that he had two 200-hp boilers with appropriate auxiliaries necessary for the operation of a small plant, and felt that a more complete or adequate log sheet adapted to such a small plant would be very helpful.

He pointed out that most of the log sheets available to power engineers were for plants much bigger than this. So we asked if readers would send in suggestions or samples of log sheets more appropriate for Mr. Border's type of plant.

Illustrated here are two sides of a single log sheet sent, in response to Mr. Border's request, by Daniel M. Roop, administrative engineer of Baptist Memorial Hospital in Memphis, Tenn. Mr. Roop says the log is used in a power plant equipped with three 300-hp water tube boilers, gas fired and with oil stand-by.

This log sheet looks as though it would be just about the sort of thing Mr. Border can use, for it seems to give all the data necessary for figuring plant performance — and all on one piece of paper, too.

Any other suggestions or samples?

BAPTIST MEMORIAL HOSPITAL
MEMPHIS, TENNESSEE POWER PLANT

DAILY LOG
ENGINEERING DEPARTMENT Date

TIME	FEED WATER: BOILER FEED (GAL)	FEED WATER TEMP. (°F)	CONDENSATE TO DEAERATOR (GAL)	STEAM PRESS. (LBS)	NO. 1 BOILER: WOOD (CU. FT.)	OILER (GAL)	FUEL (GAL)	LIGHT FUELS (GAL)	CU. RECORDER (°F)	GAS (°F)	STEAM (LBS. PER HR.)	DRUM PRESSURE (PSI)	BURNER PRESSURE (PSI)	NO. 2 BOILER: WOOD (CU. FT.)	OILER (GAL)	FUEL (GAL)	LIGHT FUELS (GAL)	CU. RECORDER (°F)	GAS (°F)	STEAM (LBS. PER HR.)	DRUM PRESSURE (PSI)	BURNER PRESSURE (PSI)	NO. 3 BOILER: WOOD (CU. FT.)	OILER (GAL)	FUEL (GAL)	LIGHT FUELS (GAL)	CU. RECORDER (°F)	GAS (°F)	STEAM (LBS. PER HR.)	DRUM PRESSURE (PSI)	BURNER PRESSURE (PSI)
7 AM																															
8																															
9																															
10																															
11																															
12 N.																															
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Side A—Daily log sheet for plant of three 300-hp gas-fired, water tube boilers

METER READINGS								CHEMICAL FEED TANKS				OIL STAND BY								
	GAS	WATER	STEAM (LBS.) BOILER 1	BOILER 2	BOILER 3	M.E. UNIT	MAIN	SO_4		PO_4										METER
								IN	LBS	IN	LBS									
7 AM								ON HAND												
3 PM								USED												
11 PM								INV.												
7 AM																				

TIME	BOILER WATER ANALYSIS: SO_4	PO_4	OH	TDS	CL	H	PH	OD FILTR.	O_2
10 AM									
6 PM									
2 AM									

SUMMARY STEAM GENERATED

M.E. UNIT
MAIN
TOTAL LBS.
TOTAL GAS CONSUMPTION CU. FT.

ENGINEER
7-3
3-11
11-7
MAKE UP WATER CU. FT.

TURBINE GENERATOR: TIME	THROTTLE PRESS	EXHAUST PRESS	AMPS	VOLTS

REMARKS:

REQUEST FOR REPAIRS:

Side B—Showing meter readings, fuel and water data on other side of sheet

WHY DOESN'T THE TOOL WEAR OUT about as fast as the workpiece?

This query, from C. G. L. of California, refers to the explanation in What Makes an Ultrasonic Machine Tool Work? The article appeared on page 80, October 1955 issue. Raytheon's Sonics Products Manager provided the answer:

> The tool tip does wear of course, but so long as the tip is softer than the workpiece, its rate of wear is much less. The following explains this apparent contradiction.
>
> Both the workpiece and the vibrating tool are attacked by the abrasive particles trapped between them. The hardened workpiece cannot contract to absorb the shock of these particles and is therefore ground away to the shape of the tool tip. The tool tip, however, is soft and resilient enough to cushion the shock and is therefore eroded rather than ground away.

REPRINTS GO TO SCHOOL — Florida's State Board of Health Director was pleased:

> On April 16, you forwarded to our agency reprints of two articles, the Automatic 24-Hr Effluent Sampler, and the Selection and Care of Sewage Sludge Filter Blankets. We certainly want to thank you for this material.
>
> We should appreciate it if you would send us 100 reprints of the above-mentioned articles. These will be placed on the registration table of the 24th Annual Short Course for Water and Sewage Plant Operators to be held at the University of Florida at Gainsville, May 27 to June 2.
>
> — *David B. Lee*

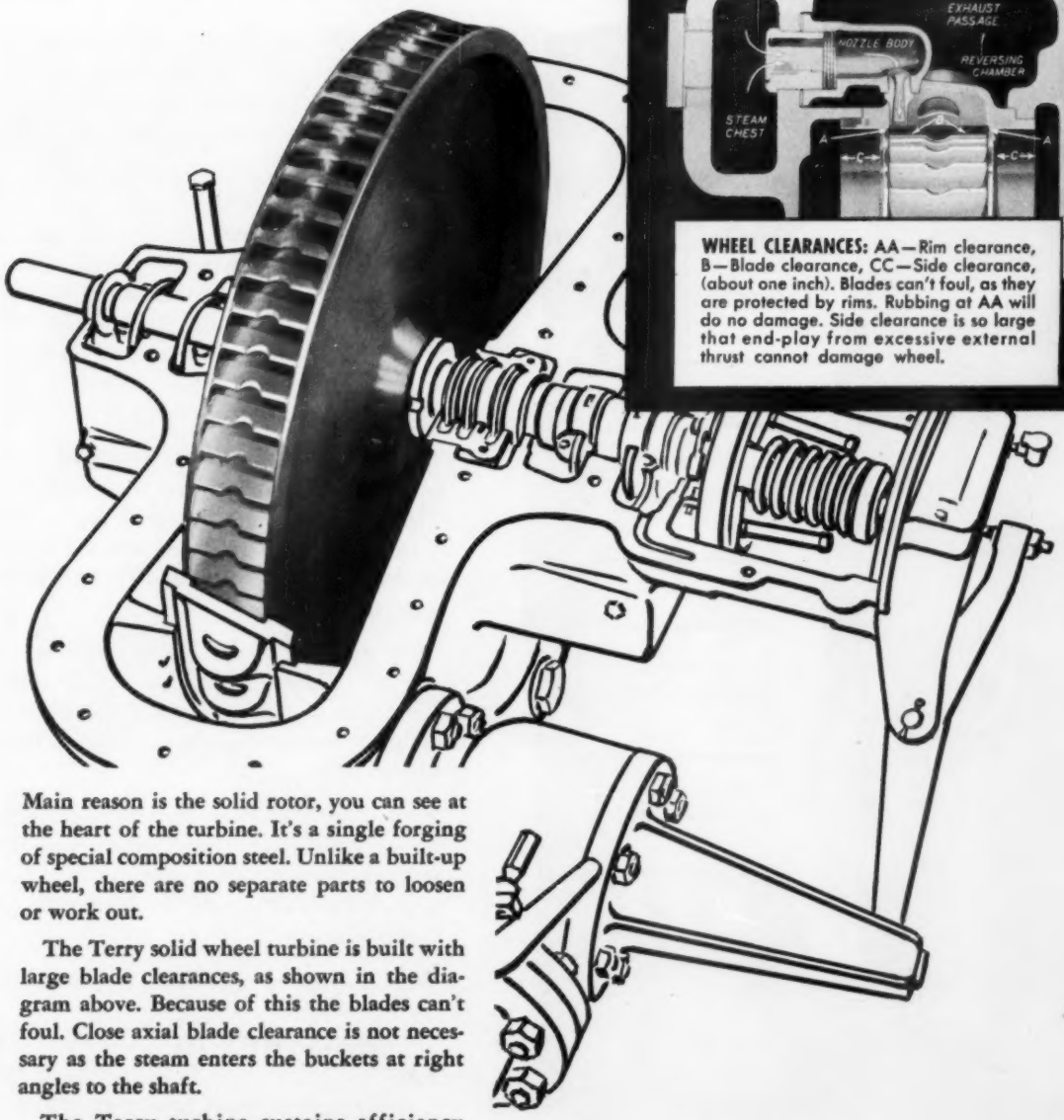
Additional reprints are available. For a copy, write What They Tell Us, POWER ENGINEERING, 110 S. Dearborn St., Chicago 3, Ill.

EDITOR KRAMER, POWER ENGINEERING'S authority on nuclear matters, gave the first major address before the scientific session of the 28th annual conference of the Petroleum Electric Power Association held May 15 at the Robert Driscoll Hotel in Corpus Christi, Tex. His subject was the influence of future nuclear power on the petroleum industry.

WHY TROUBLE GOES OUT

when this turbine goes in

WHEEL CLEARANCES: AA—Rim clearance, B—Blade clearance, CC—Side clearance, (about one inch). Blades can't foul, as they are protected by rims. Rubbing at AA will do no damage. Side clearance is so large that end-play from excessive external thrust cannot damage wheel.



Main reason is the solid rotor, you can see at the heart of the turbine. It's a single forging of special composition steel. Unlike a built-up wheel, there are no separate parts to loosen or work out.

The Terry solid wheel turbine is built with large blade clearances, as shown in the diagram above. Because of this the blades can't foul. Close axial blade clearance is not necessary as the steam enters the buckets at right angles to the shaft.

The Terry turbine sustains efficiency through the years. Reason: The power producing action of the steam takes place on the curved surfaces at the back of the buckets, so blade wear which might occur is of little consequence.

Bulletin S-116 tells more about these *"Work Horses of Industry."* Send for a copy today.

THE TERRY STEAM TURBINE COMPANY
TERRY SQUARE, HARTFORD 1, CONN.

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TT-1201

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"this is

● Engineers tell us Yarway Remote Liquid Level Indicators are the most dependable boiler insurance they can have.

Instant . . . accurate . . . brilliant . . . continuous readings of boiler water level are seen on the panel or wherever you wish in your plant. You know the readings are right because they are controlled by the boiler water itself . . . by the pressure differential between a constant head of water and the varying head in the boiler drum. *Indicating mechanism is never under pressure.*

Yarway Indicators may be equipped with a Yarway Control Unit that operates Remote Hi-Lo-Alarm signal lights or horns. For a 24-hour record of boiler water levels, use the Yarway Hi-Lo-Graph Recorder.

On the boiler drum itself you'll want Yarway Water Gages . . . and these "bright as a star" gage readings can now be televised with a Yarway—RCA Television chain.

From drum to panel and at all remote locations, Yarway equipment gives you the safest boiler protection you can buy . . . proved beyond doubt in thousands of power plants.

Write for the specific bulletins you want.

YARNALL-WARING COMPANY
100 Mermaid Avenue, Philadelphia 18, Pa.
BRANCH OFFICES IN PRINCIPAL CITIES

YARWAY®

WIDE VISION!

Clear, brilliant readings from any angle, are possible with the "wide vision" face on the Yarway Remote Liquid Level Indicator. Pointer is always visible, even at extreme high and low water levels.

The Yarway Indicator is manometric type with automatic temperature compensation, as approved for use under the ruling of A.S.M.E. Boiler Code Committee in Case #1155.

Described in Yarway Bulletin WG-1824.

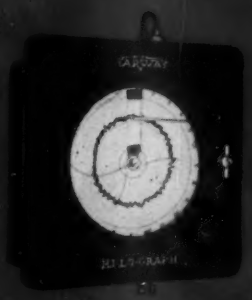
good boiler insurance!"

YARWAY WATER GAGES

Flat glass, high pressure type shown, features new separated-design insert and Type "M" illumination that causes water level meniscus to "shine like a star". Described in Yarway Bulletin WG-1812.

YARWAY REMOTE SIGNAL ALARMS

Lights or horns, operated by Control Unit on Yarway Indicator, give instant warning of any serious deviation from normal water level. Can be located anywhere in plant. Described in Yarway Bulletin WG-1824.



YARWAY RI-LO-GRAPH RECORDER

Gives a continuous 24-hour record of liquid levels. Actuating mechanism is same as in Yarway Indicator. Used both for indicating and recording. Described in Yarway Bulletin WG-1830.

YARWAY RLT TELEVISION

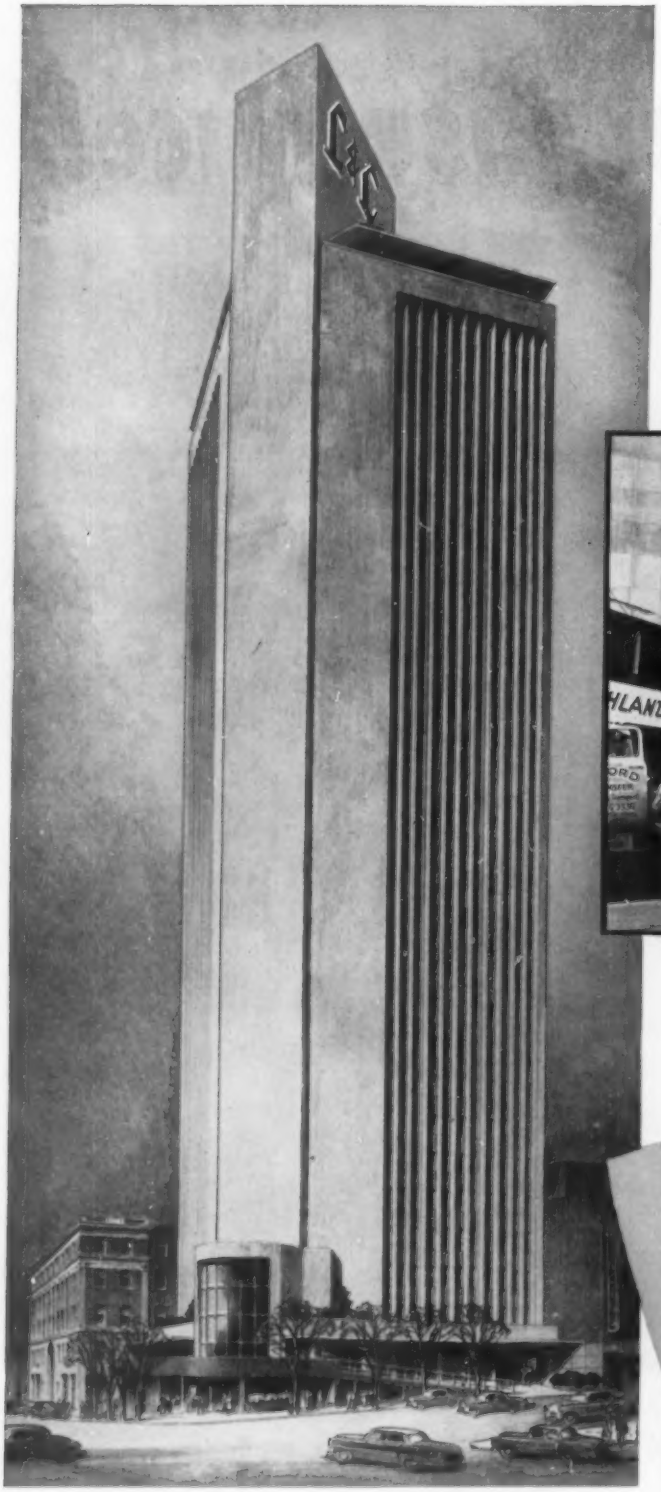
Simplified system consists of compact camera and panel-mounted monitor. Clear, bright image of water level gage anywhere in the plant.
Described in Yarway Bulletin WG-1813.

steam plant equipment

BLOW-OFF VALVES
WATER COLUMNS AND GAGES
LIQUID LEVEL INDICATORS
EXPANSION JOINTS
STEAM TRAPS
STRAINERS
SPRAY NOZZLES
DIGESTER VALVES

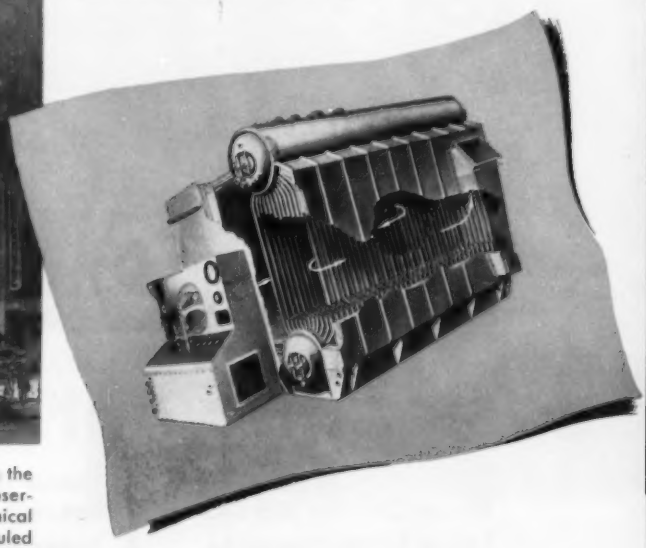
For more data circle 505 on Post Card

You can put . . . . .



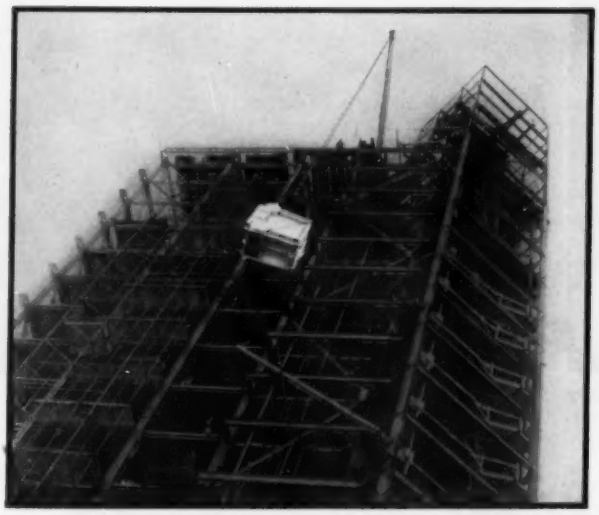
Life and Casualty Tower will be the tallest commercial structure in the southeastern United States. It contains 30 floors plus basement, observation platform and a three-story penthouse containing the mechanical equipment — including two VP package boilers. The building is scheduled for occupancy in January, 1957. It is owned by Life and Casualty Insurance Company of Tennessee.

Take It Away — First of two VP Boilers — 27,000 pounds — clears the truck bed in the first step of its 32-story journey. VP Boilers come fully assembled, ready for water, rail or road shipment anywhere in the world.



a VP boiler ANYWHERE!

. . . ***anywhere the floor-loading's adequate, of course. In Nashville's nearly-finished Life and Casualty Tower, two Combustion Engineering Package Boilers, Type VP, were installed in a 32nd-floor penthouse — nearly 400 feet above the street. The pictures show how the job was done.***



Almost Home — This VP has probably shattered the altitude record for boilers now — and it has another 30 or 40 feet yet to go. That's one of the advantages of the VP. You pick the spot and the rigging boys will find a way to move it in.

Boiler in a Penthouse — Now it's almost settled in its permanent skytop home; about set to bring up number 2. When the floor is ready, they'll hook up fuel, water and the job's done. They'll burn gas in these boilers, with oil as stand-by.

The completely shop-assembled VP Boiler, shown at left, is available in fourteen sizes from 4,000 to 40,000 lb steam per hr . . . for operating pressures up to 500 psi . . . for pressure firing of liquid or gaseous fuels. The VP Boiler has more water-cooled area per cubic foot of furnace volume than any other boiler of its size and type. The larger lower drum — 30-inch diameter — permits a simple, symmetrical tube arrangement . . . greater water storage capacity . . . easy access for washing down or inspection. A low speed centrifugal fan which is exceptionally quiet in operation is standard equipment. The simple baffle arrangement results in low draft loss . . . simple soot blowing . . . no dead pockets . . . high heat absorption. The VP is enclosed in a reinforced, gastight, welded steel casing, and shipped completely assembled with firing equipment, fittings and forced draft fan. For foundation, the VP Boiler requires only a simple concrete slab.

COMBUSTION ENGINEERING

Combustion Engineering Building • 200 Madison Avenue, New York 16, N. Y. B-928

Canada: Combustion Engineering-Superheater Ltd.

Steam Generating Units • Nuclear Reactors • Paper Mill Equipment • Pulverizers • Flash Drying Systems • Pressure Vessels • Home Heating and Cooling Units • Domestic Water Heaters • Soil Pipe

For more data circle 506 on Post Card

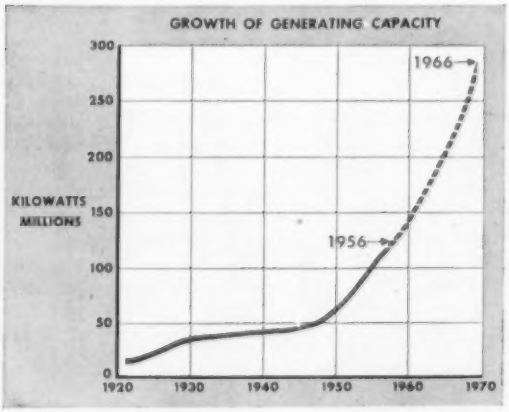
THE HIGH-PRESSURE END DIAPHRAGM WEBS are made from heavy alloy steel plates or castings. Some are ten inches thick and can withstand high pressure drops and maintain close clearances.

THE WEB is then carefully machined for welding (top). Nozzle partitions are machined from solid chrome-iron alloy and assembled in punched bands (bottom).

How General Electric builds sturdy nozzle-

GENERAL ELECTRIC MAINTAINS a continuing program of research on turbine diaphragms. This smoke tunnel provides a visual indication of how steam flow will follow new nozzle designs.

TO MEET TOMORROW'S EXPANDING LOADS



G.E. works with electric utilities and consulting engineers in these vital turbine-generator areas:

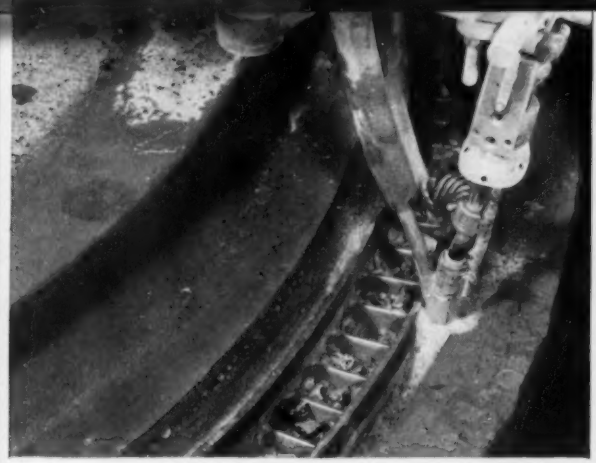
BASIC RESEARCH

APPLIED RESEARCH

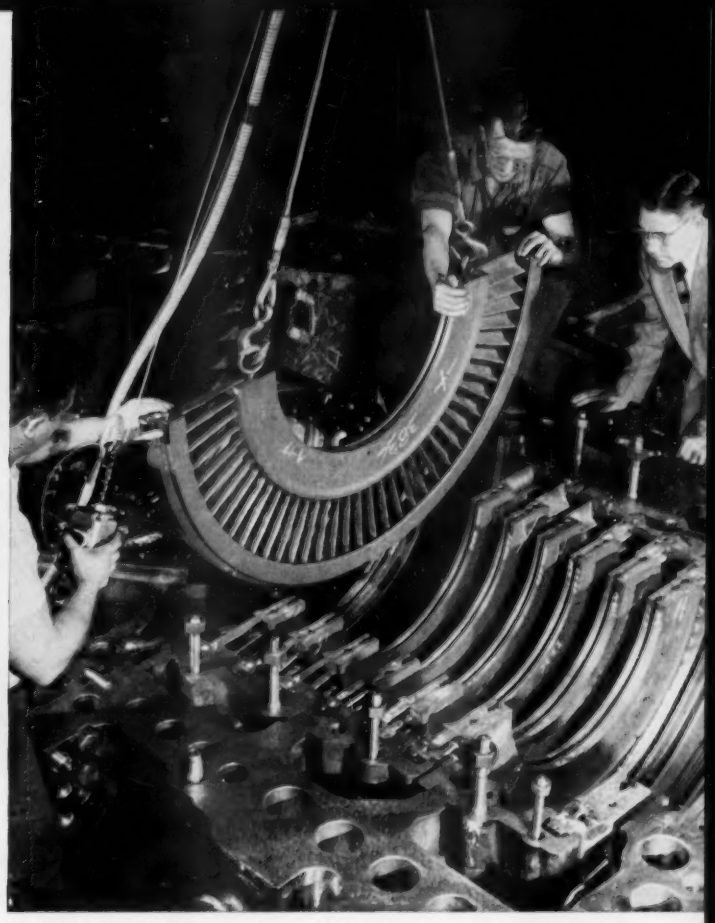
PRODUCT DEVELOPMENT: NOZZLE-DIAPHRAGMS

TESTING

MAINTENANCE



THIS NOZZLE assembly is welded to the web and outer ring (top). A finishing operation puts a high polish on the partitions for a smooth steam path (bottom).



DIAPHRAGM HALVES are lowered into the turbine shell. The rotor is then assembled and the upper shell containing the top half of the diaphragm is added to form a series of complete compartments.

diaphragms to reduce turbine maintenance

TOUGH CONSTRUCTION HELPS PROTECT STEAM PATH AGAINST DESTRUCTIVE FOREIGN MATERIALS

Internal damage to the steam path can be a costly and time consuming cause of turbine shutdown. Should large amounts of foreign material enter the steam path whole rows of buckets and partitions might be severely damaged. This could mean a long and costly outage.

TO HELP GUARD against a long outage, General Electric builds turbine nozzle-diaphragms of tough, sturdy construction. And here's how they help. Should foreign materials enter the steam path, these rugged nozzle-diaphragms "compartmentalize" damage to a small area. This greatly simplifies bucket repairs or replacement.

GENERAL ELECTRIC MANUFACTURES these diaphragms from solid castings or plates carefully machined to shape. Nozzle partitions are machined from solid chrome-iron alloy and welded to, or cast integral with, the webs. These partitions must direct the steam flow at the proper angle and velocity to the adjacent buckets.

In this and many other areas of research G.E. is working with electric utilities and consulting engineering firms to design the power makers for tomorrow's load growth. For more information on General Electric turbines write for GER-905, Large Steam Turbine-Generator Department, General Electric Company, Schenectady 5, N. Y. 254-40

Progress Is Our Most Important Product

GENERAL ELECTRIC

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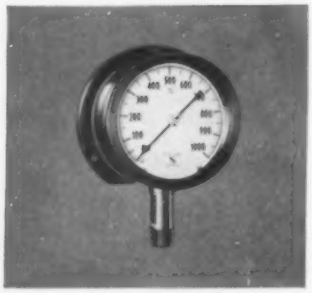
Why does the BOURDON TUBE in the ASHCROFT DURAGAUGE insure sustained accuracy?

FOR FAST SERVICE, get in touch with your Industrial Supply Distributor. He is fully acquainted with Ashcroft Duragauges and their proper selection for all kinds of applications.

8 TUBE MATERIALS permit selection of the *best metal* for particular service conditions. These materials include phosphor bronze, alloy steels, "K" Monel, stainless steels, and beryllium copper.

Every Bourdon tube used in the Ashcroft Duragauge is extra-wide – highly sensitive to slight pressure changes. Socket and tip joints are welded or brazed, then stress relieved after assembly, to assure maximum safety and uniform structure for highest corrosion resistance and strength. Each tube assembly is "whip tested" at pulsating pressures approximately 50% higher than its pressure rating to insure calibration stability.



The Ashcroft Duragauge is available with all-stainless-steel movement or stainless steel with nylon bearings and pinion gear. A choice of case designs and materials, dial sizes and pressure ranges readily satisfy the most exacting requirements. Whatever the working pressures or corrosive conditions of your operations, specify Ashcroft Duragauges and be sure of highest sustained accuracy and long service life.

In Canada: *Manning, Maxwell & Moore of Canada, Ltd., Galt, Ontario*

ASHCROFT GAUGES

A product of **MANNING, MAXWELL & MOORE, INC.** STRATFORD, CONNECTICUT

MAKERS OF 'AMERICAN' INDUSTRIAL INSTRUMENTS, 'CONSOLIDATED' SAFETY AND RELIEF VALVES, 'AMERICAN-MICROSEN' INDUSTRIAL ELECTRONIC INSTRUMENTS, *Stratford, Conn.* 'HANCOCK' VALVES, *Watertown, Mass.* 'CONSOLIDATED' SAFETY RELIEF VALVES, *Tulsa, Oklahoma.* AIRCRAFT CONTROL PRODUCTS, *Danbury & Stratford, Conn. and Inglewood, Calif.* "SHAW-BOX" AND 'LOAD LIFTER' CRANES, 'BUDGIT' AND 'LOAD LIFTER' HOISTS AND OTHER LIFTING SPECIALTIES, *Muskegon, Mich.*

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ONE OF THE GARLOCK 2,000

"KING-SIZE" FOR KINGSTON

GARLOCK RUBBER EXPANSION JOINTS

At the TVA's Kingston Steam Plant (the world's largest) the total capacity is 1,600,000 Kilowatts, made up by four 150,000 KW steam turbogenerators and five 200,000 KW turbogenerators.

80,000 sq. foot condensers, drawing 65,000 gpm. of cooling water, are spring mounted on the exhausts of the 200,000 KW turbines. 60" dia. Garlock Rubber Expansion Joints installed between condenser water inlet and concrete imbedded water piping, compensate for misalignment and provide for expansion and contraction.

These "King-Size" Rubber Expansion Joints are only part of "the famous Garlock 2,000"... two thousand different styles of gaskets, packings, and seals to meet *all* your needs... the *only* complete line available.

Call one of Garlock's 125 factory trained representatives for *unbiased* recommendations, or write for Expansion Joint Folder AD-137.

THE GARLOCK PACKING COMPANY, Palmyra, New York

For Prompt Service, contact one of our 30 sales offices and warehouses throughout the U.S. and Canada

GARLOCK

Packings, Gaskets, Oil Seals, Mechanical Seals, Rubber Expansion Joints

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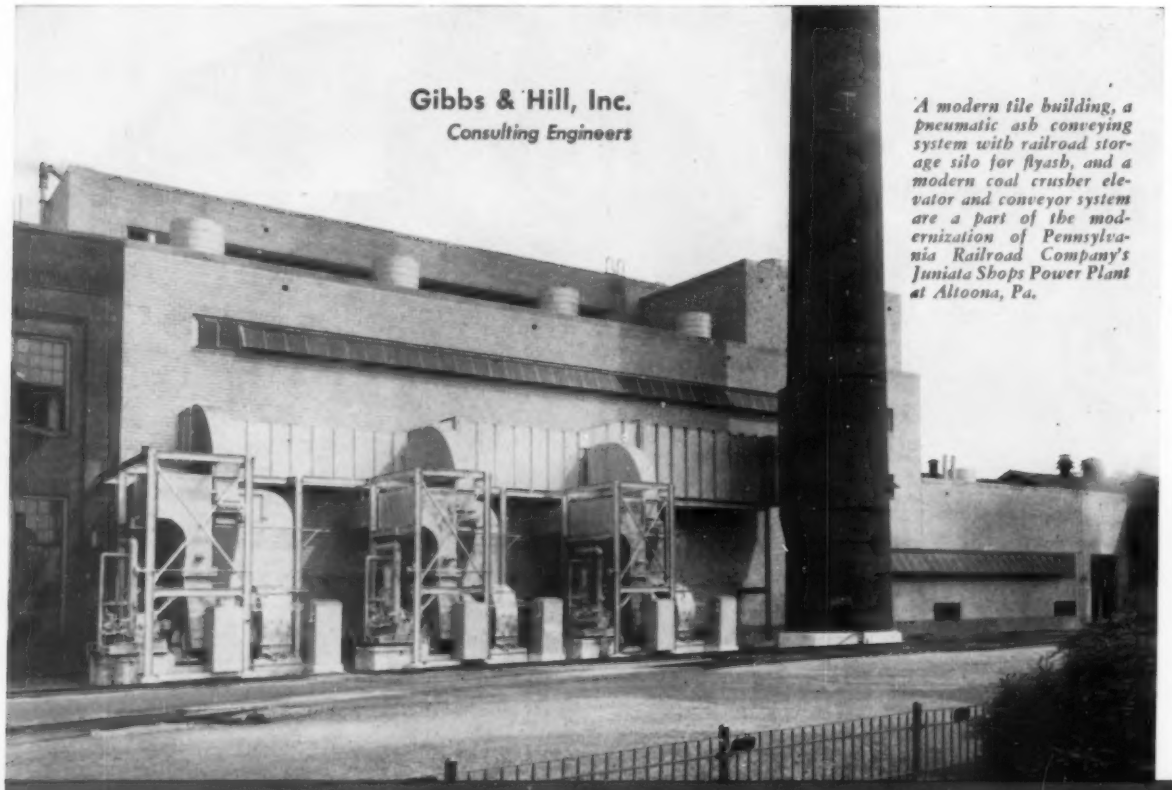
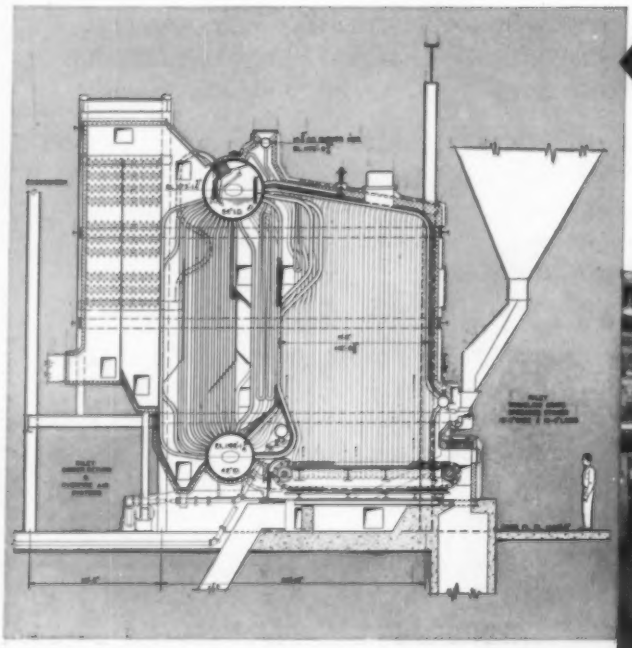


Gibbs & Hill, Inc.
Consulting Engineers

A modern tile building, a pneumatic ash conveying system with railroad storage silo for flyash, and a modern coal crusher elevator and conveyor system are a part of the modernization of Pennsylvania Railroad Company's Juniata Shops Power Plant at Altoona, Pa.

it pays to MODERNIZE . . . . and with



Three 60,000 lb/hr. complete Riley units operating at 600 psig, 675F were installed with auxiliaries and generating equipment during modernization without interruption to plant steam flow. They replace eight old units and have an efficiency rate over 85%.

Riley Traveling Grate Spreader Stokers with Riley Hydraulic Drives have a constant grate speed from zero to full load. Riley overthrow feeders feature dust tight and self-lubricating feeding mechanisms.

RILEY designs, engineers, manufactures and erects complete steam generating

Another **POWER MODERNIZATION AWARD** featuring **RILEY Steam Generating Equipment.**

Pennsylvania Railroad Modernized its Juniata Shops Power Plant

resulting in

- **40% more steam**
- **41.6% higher efficiency**
- **A net boiler investment of 2.5 mills per btu.**
- **A net annual return of 20% on investment**

RILEY STEAM GENERATING AND FUEL BURNING EQUIPMENT

As a result of an exceptionally well planned modernization program Pennsylvania Railroad Company's Juniata Shops at Altoona, Pa. now has a modern plant operating at 41.6% increased efficiency, with 40% more steam, and with exceptionally low-cost electrical generation; adding these advantages to savings in shop manhours and operating labor and lower maintenance, the net annual return on the cost of this modernization amounts to 20%: a half million dollars per year — enough to pay for the entire modernization program in five years.

A survey of your plant by a consulting engineer could show ways of making surprising savings in your power costs.

Riley Stoker Corporation equipment has played an important part in modernization programs such as this. Out of twelve companies winning POWER awards for modernization of steam power facilities in 1955, five featured Riley Boiler Units and Fuel Burning Equipment . . . and each of these Riley customers had unique programs requiring close cooperation between Riley, the customer, and its consulting engineer. This outstanding record is proof of the high quality and dependability of Riley equipment, and of Riley's ability to provide the skilled engineering and other services needed for a successful modernization program.

POWER MODERNIZATION AWARD WINNERS WITH RILEY STEAM GENERATING AND FUEL BURNING EQUIPMENT

Carbide & Carbon Chemicals Co.
Iowa-Illinois Gas & Electric Co.
Bendix Aviation Corporation
Western Electric Co.
Garlock Packing Co.
The Flintkote Co.

A FEW OTHER COMPANIES THAT HAVE MODERNIZED WITH RILEY STEAM GENERATING AND FUEL BURNING EQUIPMENT

Hawaiian Commercial & Sugar Co.
Champion Paper & Fibre Company
A & P Corrugated Box Company
Hollingsworth & Whitney
Colorado Fuel & Iron Company
Gaylord Container Corporation
Thomas A. Edison, Inc.
Continental Can Company
U. S. Rubber Co.
Kennecott Copper Container Corp.
Kellogg Company
Masonite Corp.
White Motor Co.
Stokely Foods
Carrier Corp.

RILEY
Stoker Corporation
WORCESTER, MASSACHUSETTS

Sales Offices: Worcester, New York, Philadelphia, Buffalo, Washington, Pittsburgh, Cleveland, Detroit, Chicago, Cincinnati, Charlotte, New Orleans, Atlanta, St. Louis, Kansas City, St. Paul, Houston, Denver, Salt Lake City, Los Angeles, San Francisco, Portland, Seattle.

units for Public Utility Central Stations and Industrial Power and Heating Plants

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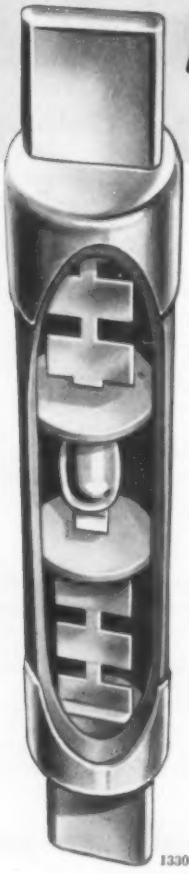

Install ECON® Dual-Element Cartridge Fuses

Workers and management both lose when harmless overloads cause needless fuse blows, resulting in "down time" and lost production. Econ Dual-Element Cartridge Fuses on motor and branch circuits offer *Double* protection: "timed" protection against overloads . . . and instantaneous action on shorts. *Only ECON Fuses have Econ-Alloy Thermo Element that gives the fullest protection against fuse failures.*

Sold through wholesalers since 1911

ECONOMY fuses for every purpose

1330 **ECONOMY FUSE & MFG. CO., 2717 Greenview Ave., Chicago 14, Ill.**

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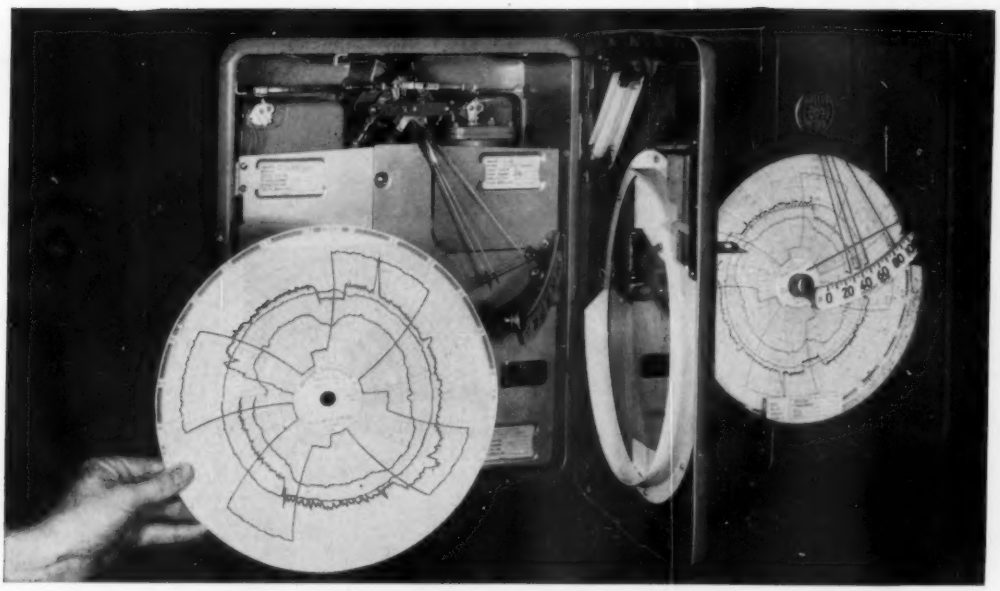

Faithfully yours –

Clear, Continuous Records without Poisoning . . . on the New Bailey Recorder

★ Faithful chart records of measured variables are the key to a meaningful, dependable analysis of operating trends and conditions. Money spent for more accurate metering, for faster response, is money down the drain—*unless* it's matched with chart records that are equally accurate.

That's why these features of the new Bailey Recorder are important to you:

1. Bailey's exclusive sealed capillary-action inking system maintains continuous flow to the pen tip, and traces sharp, opaque, quick-drying records. "Poisoning" of intersecting records is practically eliminated; no blots or smears during operation or chart changing.

2. Pens are mounted on concentric centers, trace on parallel time arcs only 42/1000″ apart. This simplifies analysis of two or more records.

3. Interchangeable plug-in receiver units permit practically limitless record-grouping combinations.

Write for Product Specification E12-5 and actual chart sample. PB2-1

ONLY BAILEY OFFERS ALL THESE ADVANTAGES IN A SINGLE RECORDER

- Pre-calibrated plug-in receiver units
- Up to four pneumatic or electronic receivers —or two receivers and two integrators
- Any four variables on one chart—easily read and interpreted
- A full year's ink supply at one loading
- Faster shipment—from stock
- Minimum inventory of parts
- Minimum instrument investment for process cycle expansion or alteration

BAILEY METER COMPANY
1040 IVANHOE ROAD
CLEVELAND 10, OHIO
Controls for Power and Process

BAILEY METERS
Controls for
TEMPERATURE
PRESSURE
GAS ANALYSIS
FLOW · LEVEL
RATIO · DENSITY

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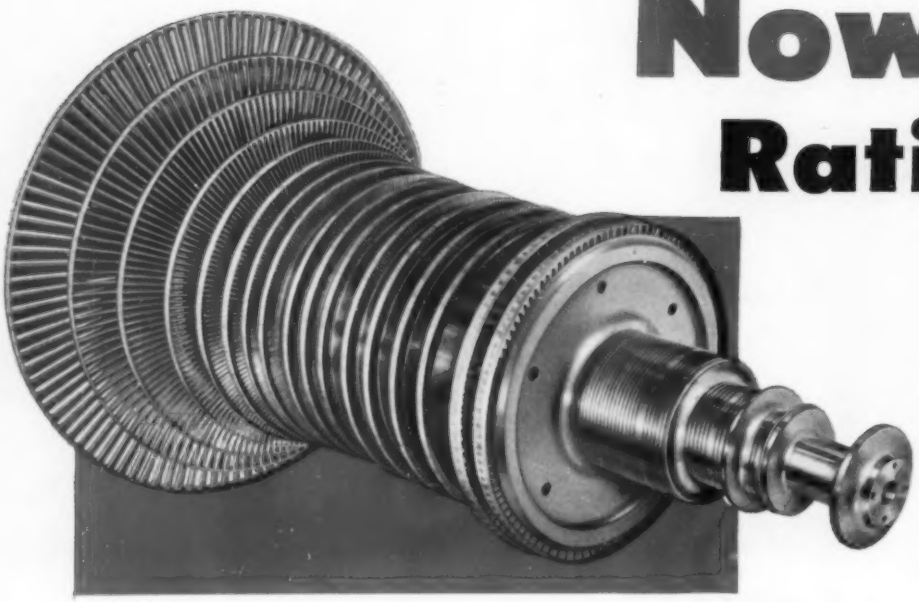
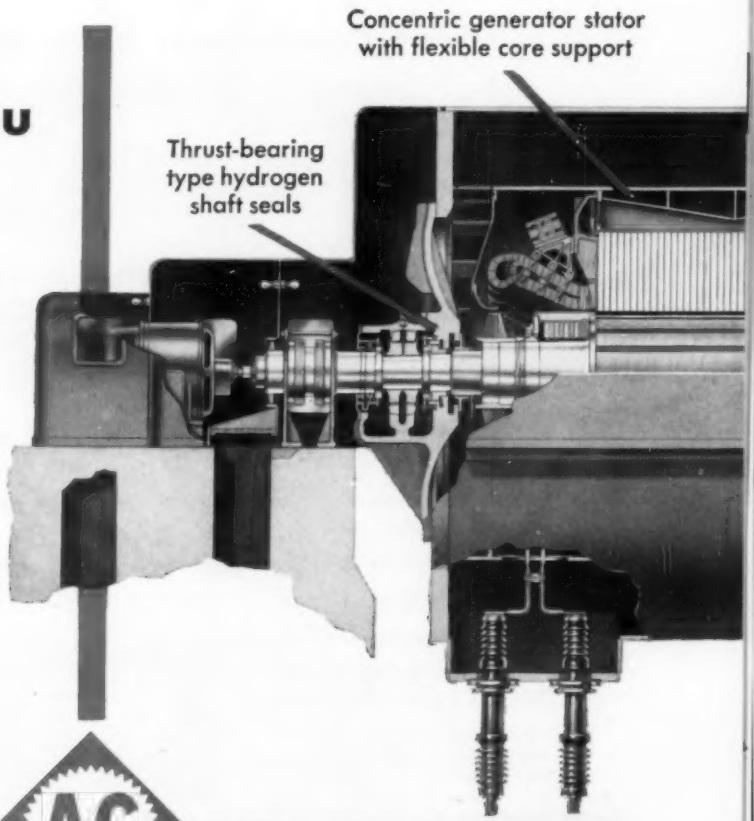
Now in Ratings



Here is the turbine rotor for one of the 16,500-kw units now being built. For this 850-psig, 900-F AIEE-ASME turbine, rotor shaft and wheels are of integrally forged construction.

Allis-Chalmers Turbines Give You MORE Modern Design Features



CUTAWAY VIEW of 16,500-kw unit shows the development of impulse turbine design for larger ratings.

A-C ALLIS-CHALMERS

ALLIS-

Production up to 16,500 Kw

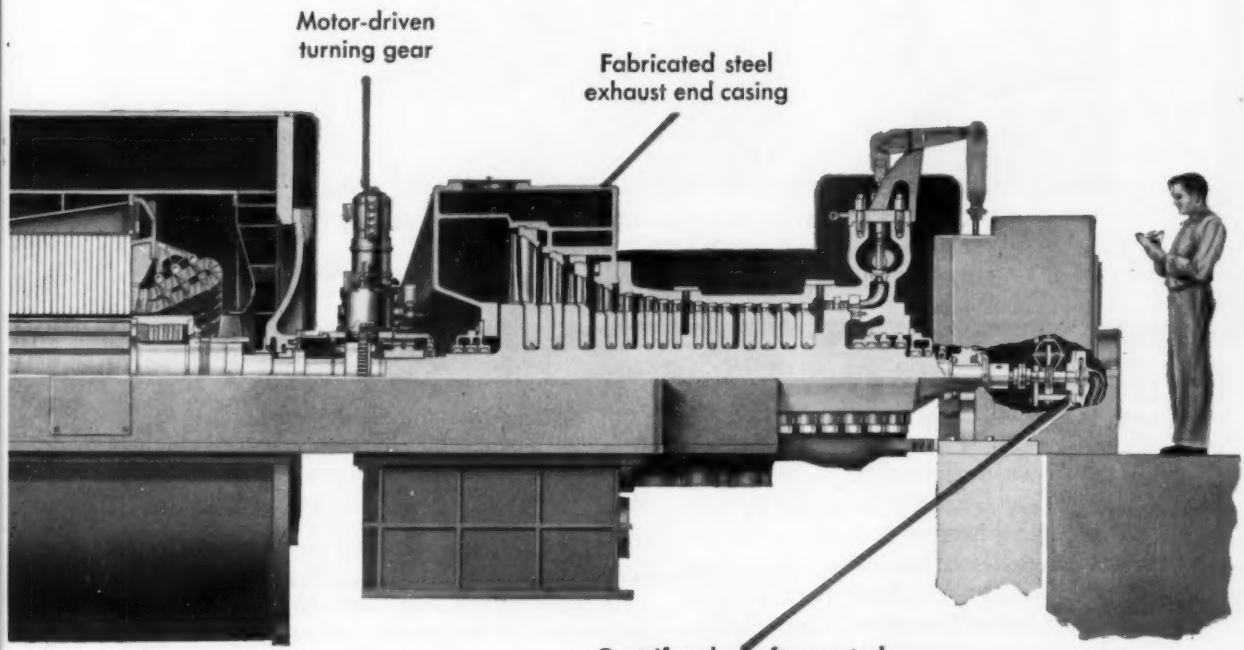
NEW Large WA-Series Turbines Offer

- Advanced Design Features
- Simplified Installation
- AIEE-ASME and NEMA Ratings

NEW WA-Series steam turbine-generator units now being manufactured include the 10,000-kw NEMA standard rating as well as 12,650-kw and 16,500-kw AIEE-ASME preferred standard condensing ratings. The 16,500-kw units have hydrogen-cooled generators.

Incorporated in the design are time-proved labyrinth steam sealing, removable external glands, high chrome alloy steel buckets and nozzles, reliable governing system, and unit shipment and installation — plus additional large turbine and generator features.

To get MORE information on economical, dependable units 2000 kw and larger, call the nearest A-C district office, or write Allis-Chalmers, Power Equipment Division, Milwaukee 1, Wis.



CHALMERS

LIVE BETTER ELECTRICALLY

A-5127

For more data circle 513 on Post Card

The Power Plant Engineer Said:

"I WOULDN'T KNOW..."

INQUIRING REPORTER: So you use Nalco System water treatment ... How often are your boilers turbined?

ENGINEER: I wouldn't know—only worked here seven years.*

* You recognize the Engineer's answer as a twist on the old one about *How-often-do-you-get-a-raise-around-here.* Our excuse for bringing it up is that the engineer's answer applies to hundreds of plants using Nalco water treatment. New plants, starting boilers from scratch with Nalco, report years on line, *billions* of pounds of steam generated in boilers that have *never* been turbined ... and probably never will be. Older plants, where turbining was as routine as checking the draft gauges, now open boilers only to show the inspectors.

These Nalco *results* can quite possibly be duplicated in your plant, regardless of the kind or severity of your water treatment problems ... or the size of your operation. Write or phone, now, for a fast start toward permanent water treatment security.

NATIONAL ALUMINATE CORPORATION

6224 West 66th Place • Chicago 38, Illinois

Telephone: POrtsmouth 7-7240

In Canada: Alchem Limited, Burlington, Ontario

THE *Nalco*® SYSTEM ... Serving Industry through Practical Applied Science

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HELPFUL BULLETINS

PUMPS AND COMPRESSORS

101 Centrifugal Pumps — Eight-pp Catalog A-156 describes and illustrates double-suction single-stage centrifugal pumps for general service where liquids of low viscosity are to be moved. In these pumps the case is split on horizontal center line and rotating parts can be removed for maintenance without disturbing piping. Cross section drawings and construction details included. C. H. Wheeler Mfg. Co.

102 Chemical Pumps — Bulletin 1050 details features and specifications of company's canned motor pumps for general process pumping. Included are performance curves, dimensions, principles of construction and operation, cutaway views, materials available, power requirements. Chempump Corp.

103 For Ash Handling — Data Sheet Pa, 12 pp, features an improved line of A-8-H Hydroseal pumps for hydraulic ash handling systems. Photos, schematics and line drawings illustrate design, construction and operation of these abrasion resistant centrifugal pumps. Tables give pumping capacities and related data, including friction loss in pipe and fittings. Cutaway illustrates principle of operation. The Allen-Sherman-Hoff Co.

104 For Hydraulic Services — A solution to pump upkeep problems is presented in 8-pp Form 7248-A describing maintenance-free pumps for hydraulic service. Includes cutaway photos showing important features and pictures typical installations. Specifications, interchangeability table, and dimensional data are included. Ingersoll-Rand Co.

105 End Suction Pumps — Easy stocking, ordering, storing and application are advantages of company's end-suction pumps packaging plan described in 8-pp Bulletin B-2319. It contains complete pump descriptions and a selection chart, as well as head-capacity performance curves for 22 pumps. Peerless Pump Div., Food Machinery and Chemical Corp.

106 Chemical Pump — Descriptive and engineering data on company's chemical pumps for all-purpose pumping of chemicals are presented in this informative brochure. Specifications are tabulated and a dimensional drawing is included. O.K. Machine & Tool, Inc.

107 Reciprocating Compressor — Bulletin F-80 is a 16-pp engineering catalog describing company's Type FMP compressor, a reciprocating unit built for pick-up service, gas boosting, general industrial use. Design and construction features are detailed and illustrated, and typical space plans are included. Ratings of the Type FMP are up to 600 hp as belt-driven or packaged. The Cooper-Bessemer Corp.

PACKINGS, SEALS

108 Teflon Packings — Eight-pp Form 6906 illustrates and describes split and folded types of envelope gaskets, solid gaskets and Teflon stuffing box, Vee-Flex, braided, plastic and various types of valve stem packings. Complete service recommendations for each type are included, as well as sizes available. Packing Div., Raybestos-Manhattan, Inc.

109 Mechanical Seals — Bulletin S-205-2, 8-pp, covers the complete line of chemically inert mechanical seals for handling all types acids, corrosives, solvents and gases. Provides construction, service and application information, installations and engineering details. Crane Packing Co.

MECHANICAL POWER TRANSMISSION

110 Right-Angle Gearmotor — Booklet B-6579 presents company's Type R right-angle gearmotor for applications requiring 1 to 30 hp. By photos and diagrams, this bulletin describes construction and operation of the gearmotor, including double-enveloping gears utilized. A chart shows relationship between output torque capacity and total gear ratio. Westinghouse Electric Corp.

111 On V-Belts — Bulletin V-1400-B20-P, 8 pp, shows Worthington-Goodyear V-belts for drives used in heavy industrial applications and miscellaneous light drives. Featured are steel cable belts with highest hp ratings of standard section V-belts, especially adaptable for drives requiring extra strength and heavy continuous service. Also described are HY-T belts, a premium-rated synthetic fiber with surplus stretch removed; cord V-belts; open-end V-belts; light-duty V-belts and others. Worthington Corp.

112 Electric Brakes — Eight-pp Bulletin WEB 6212 describes primary electric brakes, clutches, and clutch-brakes which utilize an electro-magnetic principle to provide a simpler, more versatile way to control a wide variety of machine motions. Includes complete specifications, cutaway views and photos showing component parts. Warner Electric Brake & Clutch Co.

INSTRUMENTS AND CONTROLS

113 Feedwater Controller — Bulletin 5623 suggests a practical solution to out-of-bounds initial, operating and maintenance cost of boiler water level control. Points out advantages of the feedwater controller and lists typical specification. The C. E. Squires Co.

114 For Remote Transmission — Bulletin 700, 16 pp, features the Orthoflow system for rapid transmission of metering data from one location to another. Describes versatility of the system for transmission of flow data, liquid level data, or pressure measurement data, and contains diagrams of each type of application in addition to dimensional drawings and capacity charts. Simplex Valve & Meter Co.

115 pH Conductivity Instruments — Catalog 1551, 20 pp, includes information about latest equipment for measuring, indicating, recording and controlling the electro-chemical variables: pH, Redox, and conductivity. Fundamentals of electrochemical instrumentation are reviewed, and basic systems are described. Also included are illustrations of charts. Minneapolis-Honeywell Regulator Co.

116 Automatic Oscillograph — Bulletin GED-3049, 16 pp, gives all the facts and figures on this fully automatic instrument for monitoring power system transmission circuits. Outlines seven features which assure quality performance and convenience and includes specifications and a schematic diagram of oscillograph operation. General Electric Co.

117 H_2S Detector — Development of an improved type hand-operated detecting instrument for hydrogen sulfide is announced in Bulletin 0805-1. Describes principle of operation, how to make test, and includes cutaway view showing component parts. Mine Safety Appliances Co.

118 Meter that Pumps — Bulletin 300, 8 pp, describes company's improved meter that pumps — designed for precise metering and proportioning of small quantities of low viscosity fluids at low cost, over extended periods of time. Complete capacity tables and a detailed schematic are also included. Hills-McCanna Co.

New and revised publications reviewed on these pages offer help on operating and maintenance problems. To order, use the handy Reader Service Cards provided on pages 113 and 114

119 Outdoor-Type Heat Controls — "Modern Control of Building Temperatures from Outdoors" describes outdoor-type automatic heat controls. These include: time switches, set automatically by outdoor weather; controls in which outdoor temperatures automatically regulate hours of building heat generation and rate of heat flow; and indoor-outdoor controls which alter heating system's temperature of water or air as outdoor temperature changes. Automatic Devices Co., Inc.

121 Improved Chlorinators — This bulletin introduces the V-notch Variable Orifice, described as a new and outstanding development for controlling chlorine gas flow. Illustrates chlorinator and explains design advantages including wide range adjustment of flow, same accuracy over entire wide flow range, others. Wallace & Tiernan Inc.

122 Panel Instruments — Bulletin GEC-368H, 12 pp, describes the features, application, construction, dimensions and other data of 2½-, 3½- and 4½-in. sizes of panel instruments and accessories. Includes tables listing physical, operational and electrical data, and includes dimensions and panel-drilling plans. General Electric Co.

HEATING, VENTILATING AND AIR CONDITIONING

123 Heating, Ventilating — Complete price and engineering information

on company's air conditioning, ventilating, refrigeration and heating equipment is featured in this 38-pp 1956 Estimating Catalog. Covers fans, roof ventilators, air conditioning units, heating and cooling coils, condensing units, cooling towers, unit coolers, air heaters, condensers, control valves, forged flare fittings, pumps, motors, starters, switches, controls, filters, insulation, instruments, and other accessories. M. Blazer & Son.

124 Liquid Chillers — Form ACC-179, 6 pp, describes and gives capacity data on more than 30 different models of packaged liquid chillers. Photos, cutaway views and drawings illustrate design, construction and applications in various industries. Airtemp Construction Corp.

125 Refrigerating Machine — Bulletin 1426, 8 pp, describes single-stage hermetic centrifugal refrigerating machine for comfort air conditioning and process air conditioning. Cutaway photo illustrates design and operation features. American Blower Corp.

126 Central Air Conditioners — These specification sheets, designated as Bulletins C-1100-S106P, S107P, and S108P, give complete dimensions and operating data on both vertical and horizontal models of company's line of central station cabinet type air conditioning units. Outstanding features such as flexibility and compactness are described. Worthington Corp.

127 Baseboard Heating — Sixteen-pp Bulletin 1231 contains photos, drawings and technical data on company's baseboard heating. Gives roughing-in-data, design and details of typical installations, capacities and procedures for selecting baseboard systems. C. A. Dunham Co.

DUST CONTROL

128 Electronic Air Cleaner — Twelve-pp Catalog E-61 features complete engineering data, size and capacity tables and component parts description on company's electronic air cleaners. Dimension, capacity and selection table is included. Describes applications in various industries. Trion, Inc.

129 For Super-Clean Air — Bulletin 557-D describes company's Ultra-Filtration collector for ventilation, cooling or air conditioning of electrical control rooms, laboratories, precision manufacturing areas, electric motors, and transformers; for process air to blowers, and diffuser plates; to pressurize work spaces in dusty areas. Dimensional diagrams and specifications are included. Wheelabrator Corp.

130 Electronic Air Cleaner — Catalog B-1425, 8-pp, describes and illustrates an electronic air cleaner for commercial and industrial applications. Complete with pictures, drawings and specifications, bulletin explains the cleaning of air by electrostatic precipitation and describes installation, operation, and maintenance of the units. Also covers movable nozzle washing and adhesive application, which permit these two cycles to be completely controlled and operated from outside the unit. Westinghouse Electric Co.

VALVES, PIPING AND FITTINGS

131 Magnetic, Motorized Valves — Catalog V-55, 20-pp, illustrates and lists specifications of magnetic and motorized valves for use with air, water, gas, steam, oil and refrigerants. Covers gas valves, hydramotor and magnetic valves and includes photos, dimensions, application data, tables listing sizes, capacities, operating pressures and other data, as well as full specifications for each type of valve described. The Mercoid Corp.

132 Air Valve — Well documented and comprehensive, 12-pp Bulletin 200 describes Type CCAV controlled closing air valve — announced as a new concept for the protection of pipe lines against damaging effects of surge and built-up pressures or water hammer. Includes cutaway drawing showing design and operation features, installation drawings, dimension tables. Simplex Valve & Meter Co.

133 Bronze Globe Valve — Circular 605 details the advantages of company's bronze globe valve designed for higher-pressure applications. Includes cutaway view showing component parts and a table of dimensions. The Lunkenheimer Co.

134 Slide Valve — Data Sheet Ub describes slide valves designed especially for use in pipeline transporting solid materials in liquids. Details of construction are covered in text and illustrated, together with operating mechanisms for manual or power operation. Line drawings with dimension tables give additional data. The Allen-Sherman-Hoff Co.

135 Gate Valves — Circular V-126 describes company's renewable seat ring gate valve which never has to be removed from the line to replace seat rings. Includes photos and dimensional data. The Fairbanks Co.

136 Non-Return Valves — Six-pp Bulletin S-2 describes and illustrates company's Cushioned single-acting non-return valves. Discusses adaptability, sequence of operation and servicing of these valves. Body and yoke patterns available are shown, and dimensions and specifications provided. Golden-Anderson Valve Specialty Co.

137 Unions and Fittings — Advantages of company's line of unions and union fittings are outlined in illustrated Bulletin D 255. A sectional view points out outstanding features and table lists specifications. The Fairbanks Co.

138 Plastic Pipe, Fittings — Two types of unplasticized PVC pipe and fittings are described in 6-pp Bulletin T.D. 119 — a normal impact grade and a high impact grade. Advantages of both types are given. Applications are listed by industry and process, and the full range of corrosion resistance is defined. Tables show physical properties, dimensions and weights, working pressures, burst pressures, other data. Installation instructions included. The Carpenter Steel Co.

139 Pipe Nipples — Catalog 708B describes flexible pipe nipples for strain-free connection of air or gas lines to industrial oil or gas burners. Includes chart showing how to select required length of bellows for special flexible nipples. Also details advantages of company's product and includes specifications. Hauck Mfg. Co.

140 Steel Pipe, Tubing — This 6-pp folder No. TDC-163A, furnishes information on analysis, mechanical and physical properties and creep and rupture data on many tubing alloys which are satisfactory in elevated temperature service. Table also lists data on applications, short time strength, oxidation resistance, corrosion resistance, and working qualities. Tubular Products Div., The Babcock & Wilcox Co.

141 Improved Connectors — Bulletin 407 presents a line of split-flange connectors produced for the aircraft industry, now available for general industrial use. According to bulletin this type of connector won't leak or loosen, is adaptable to any tubing joint, saves space, and is suited for hydraulics, steam and gases. Five styles are shown. Barco Mfg. Co.

. . . Outstanding Among This Month's Catalogs

142 Steam Pump Care — Bulletin G-2280, "How to Install and Take Care of Steam Pumps," is a 24-pp booklet containing a step-by step series of 88 illustrations showing how to increase the service life of all types of steam pumps. It offers 28 tips on proper installation of the pumps, 54 tips on care techniques. Section on installation provides information on suction, pump, packing pump, starting, and trouble shooting. Section on maintenance deals with such subjects as steam valves, liquid piston and rod, piston packing, liners, valve service, and gaskets. Worthington Corp.

143 V-S Drive Selection Tips — Bulletin 20P50, 44 pp, carries handy multi-color tables for quick and easy selection of variable speed Texrope drives. In addition to providing these tables for A, B, C and D section variable speed drives, booklet includes information on design features, drive principles, horsepower rating tables for A, B, C, D, and E section belts, a speed range table showing variation in rpm when using two Vari-Pitch sheaves in combination. Allis-Chalmers Mfg. Co.

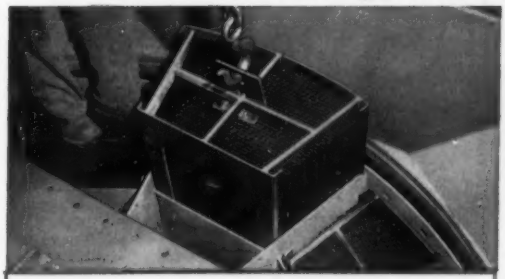
144 On Copper Conductors — Publication C-25, 62 pp, is designed to help make the selection of bus conductors easier. Included in booklet are tables regarding such shapes as channels, ventilated square tubes and round tubes. There are tables for other rigid bus conductor shapes, also data on bare copper wire and cable as well as commonly used alloy wires. Also provided is a general discussion of copper, its physical and electrical properties. Photos illustrate many installations. The American Brass Co.

HEAT EXCHANGERS, TUBING

145 Air-Cooled Exchangers — Bulletin 2400, 24-pp, describes latest developments in air-cooled heat exchangers, covering design details, construction, distinctive features and applications. Also included are specifications, sketches of available arrangements, and descriptions of mechanical equipment and control apparatus for various service requirements. The Griscom-Russell Co.

146 Heat Exchanger Tubing — Cited in this 30-pp catalog are typical cases where cupro-nickel or Monel tubing installed in heat exchangers resulted in substantial savings and better efficiency through longer tube life. Describes applications of this tubing in various instances where unusual water conditions, as to pol-

air preheater installations are Ljungstrom®



Advantages of the Ljungstrom Air Preheater

- Size for size, recovers more heat than any other type.
- Reduces fuel consumption. Permits use of lower-grade fuels. Increases boiler output and reliability.
- Eliminates cold spots...keeps corrosion to a minimum.
- Easier, faster to clean and maintain.
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MINIMUM CORROSION is an important reason. There are no cold spots in a Ljungstrom. Temperature is uniform on all heating surfaces—corrosion-causing condensation is reduced.

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PlastiCal—with lead-calcium grids for maximum life—is conservatively engineered for at least 25 years in full-float service. PlastiCell—with high-tensile alloy grids—has a projected life of 14 years in float service.

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lution, excessive turbulence, temperature and the like, required tubing that would withstand this rigorous wear. The International Nickel Co., Inc.

ELECTRICAL, LIGHTING

147 Low-Voltage Equipment — Publication 1032-A is the 160-pp 1956–57 general catalog covering manufacturer's low-voltage electrical distribution equipment and components. It is offered as a source of information for specifying such equipment for applications up to 600 v. Catalog contains photos, descriptions, ratings, list prices and application information on: lighting and distribution panelboards, motor control centers, distribution center unit substations, safety switches, open knife switches, molded case circuit breakers and service entrance equipment. Available to qualified power engineers, please state your job title when requesting this. General Electric Co.

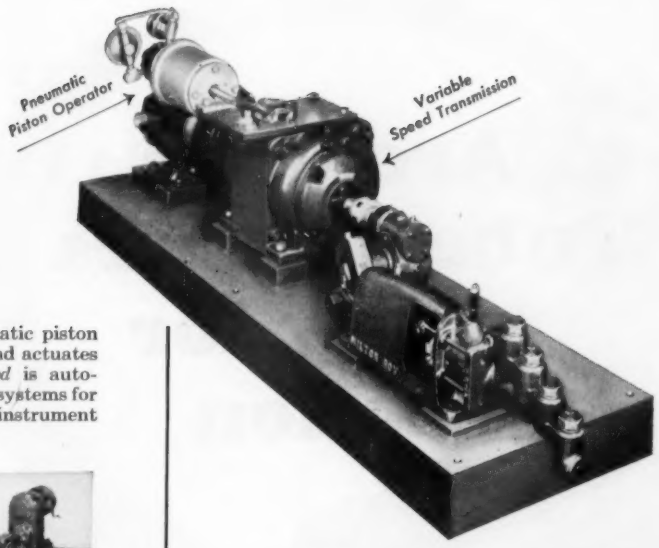
148 Permanent Magnet Motors — Catalog F-4344-3 describes company's line of fhp d-c permanent magnet motors as well as gearheads, centrifugal blowers, and tachometer generators, designed for industrial applications with many combinations of voltage, output, and speed. Specifications are tabulated and motor mounting details illustrated. Barber-Colman Co.

You'll save time in ordering bulletins by using the Reader Service Cards on page 113. Of course we honor letterhead requests—but it takes us somewhat longer to handle them.

149 Industrial Systems — Bulletin GED-3039, 48 pp, gives information on distribution system planning. Features, advantages, application, operation and other data on system-engineered equipment for industrial power distribution, including switchgear, unit substations, switchboards, transformers, busways, wire and cable, conduit products, voltage regulators, capacitors, circuit breakers, safety switches, panelboards, controls, motor controls, motors, turbines, rectifiers, and wiring devices are covered. Photos, diagrams and drawings, specifications are included. General Electric Co.

150 For Commercial Buildings — Bulletin GED-3038, 40 pp, discusses factors to be considered in planning an electrical distribution system for commercial plants. Covers features, advantages, application, operation and other information on system-engineered equipment for commercial power distribution, including higher-voltage circuits, switchgear, switchboards, unit substations, cutouts, transformers, busways, wire and cable, conduit products, and others. Photos, cutaway views and diagrams illustrate text. General Electric Co.

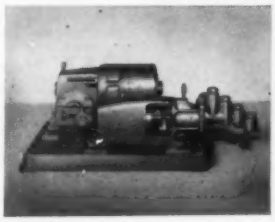
151 Automatic Switches — Publication 596, 16 pp, discusses factors to consider in the selection of automatic transfer switches. Additional information includes selection of type, how to specify the switch capacity, calculating line currents, and suggested specification for automatic transfer switches. Photos showing component parts and wiring diagrams are included. Automatic Switch Co.



In this Controlled Volume Pump, a pneumatic piston operator receives an instrument air signal and actuates a variable speed transmission. Pump *speed* is automatically adjusted to process demand. Servo systems for automatic adjustment of stroke *length* by instrument air signal also available.

This pump is a 4-cylinder formulating unit. All liquid ends are powered by a variable speed drive, manually adjustable. Stroke length of each liquid end is individually adjustable, manually.

Standard motor-driven, simplex - controlled volume pump, with constant speed motor and manual adjustment of stroke length.



This formulating pump has two "miniPumps" (capacities in milliliters per hour) and one standard motor-driven pump, all powered by one constant speed drive. Stroke length of each unit is manually adjustable while pump is in operation.

Which pump is best for YOU?

Write today for application data on Controlled Volume Pumps in:

Paper Making (Bulletin 455)
Industrial Water Treating (Bulletin 953)
Process Instrumentation (Bulletin 1253)

Broad flexibility for metering process additives

If you pump and meter chemicals against a head . . . or maintain fixed ratios of two or more chemical streams . . . or automatically regulate flow of a control agent in a control system, such as pH, there's a Milton Roy Controlled Volume Pump that's exactly *right* for your application.

Illustrated are a few of many flexible adaptations in simplex, duplex and formulating pump designs that are available from Milton Roy, with manual or automatic adjustments of stroking length or speed. Capacities range from 3 milliliters per hour to 45 gpm, pressures up to 50,000 psi. Accuracy of delivery is within plus or minus one percent. Liquid ends are furnished in a wide selection of alloys and in plastic. Sanitary design, too.

Have you investigated how you can reduce chemical costs and upgrade product quality by using controlled volume pumps? One of the bulletins listed probably contains the economical answer to your chemical metering problem. Milton Roy Company, Manufacturing Engineers, 1300 East Mermaid Lane, Philadelphia 18, Pa.

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152 Outlets Unlimited — "The Modern Way to Provide Convenience Outlets Unlimited" is the title of 12-pp Form 589, on Plugmold systems. Illustrates and describes five sizes of raceways, with capacities to 10 No. 6 conductors. Shows Plugmold systems for applications in heavy and light industry, offices, others. The Wiremold Co.

153 Receptacles, Plugs — Bulletin 238, 8 pp, describes company's receptacles, plugs and binding posts. Illustrates both socket and pin receptacles and socket and pin plugs. Dimensions and capacities are given. The Standard Electric Time Co.

154 Strongbox Solenoids — Bulletin GEA-6215A, 16 pp, gives new application and accessory information on company's industrial strongbox solenoids. Includes descriptive material on terminal covers and linkage pins, detailed outline dimensions on a-c strongbox solenoids, and new price figures. Photos, diagrams, and force and current curves are included. General Electric Co.

155 Fibre Conduit — Catalog 52, 12 pp, outlines uses and advantages of company's fibre conduit, an underground protective raceway for electric cables. Includes photos and drawings illustrating important features and typical installations, as well as listing specifications. Orangeburg Mfg. Co., Inc.

156 Cable Ladder — Specification and design data on company's ladder support system for holding cables and tubing are presented in 12-pp Bulletin 156-E. Dimensional diagrams are included. P-W Industries, Inc.

157 Mercury Vapor Lighting — "Better Industrial Lighting with Mercury Vapor," 12 pp gives eight reasons why industrial plants have switched to mercury vapor lighting. Use of color-improved mercury vapor lamps and of clear mercury vapor lamps in combination with other lighting to meet special color requirements is treated. Booklet also provides technical data and operating characteristics on the lamps, some facts on cost, and engineering hints for effective installation. Sylvania Electric Products Inc.

MATERIALS HANDLING

158 Crawler Tractors — Mechanical features of the complete line of company's crawler tractors are described in illustrated Bulletin CR-553-F. Includes on-the-job photos and close-ups of outstanding features, such as improved operator visibility, push-button starting, 500-hour track roller seals, pressurized cooling system and others. International Harvester Co.

159 Excavating, Conveying — Catalog Section A, 30 pp, gives full details and specifications on Dragscraper machines for low-cost excavating and conveying. Data on standard installations from ⅛ to 3 cu yd and rapid shifting Dragscrapers in sizes from ⅛ to 5 cu yd are given, and typical installations are shown. Track cable machines and tower excavators are also covered. Sauerman Bros., Inc.

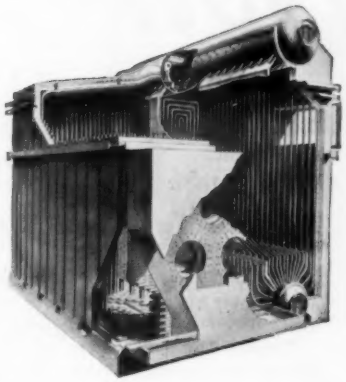
WATER TREATING

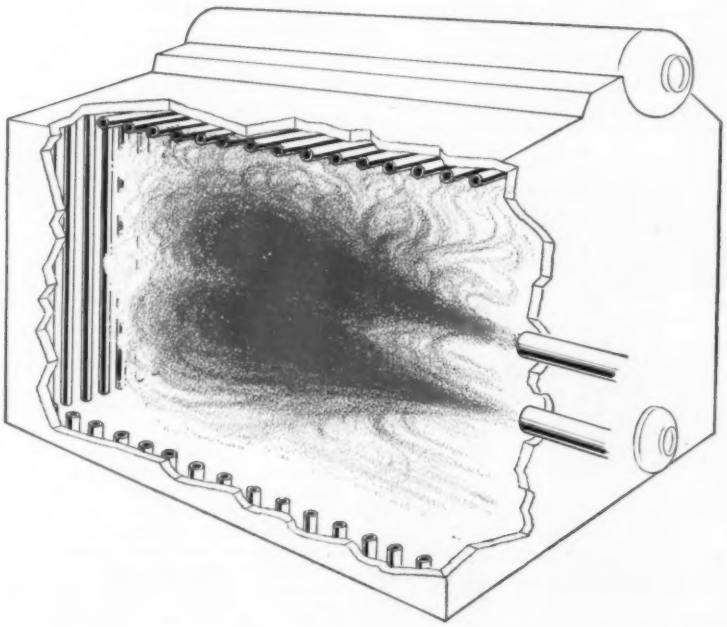
160 On Demineralization — Technical Reprint T-140, 24-pp, a profusely illustrated article on demineraiization, discusses advantages and disadvantages of

Another Feature of the FW Series "SC" Standard Boiler

EFFICIENT FIRING ARRANGEMENT

assures Longer, Trouble-Free Service





Simplified, schematic diagram showing firing arrangement of typical "SC" steam generator.

The furnace arrangement is carefully designed to permit excellent combustion of the fuel without impingement of the flame on any of the tube surfaces. This prevents harmful overheating and contributes to longer, trouble-free performance.

The rear wall of the firing chamber is over 19 feet from the burner wall, permitting long, horizontal flame travel. The flame envelope, as indicated above, occupies the major portion of available furnace space, greatly reducing ineffective or unused furnace volume. This same basic combustion principle has provided years of successful operation in many other types of FW boilers.

FW Series "SC" Steam Generators are available in capacities from 50,000 to 150,000 lb/hr, for pressures to 1500 psi and superheated steam temperatures to 950 F.

For further information, write for Bulletin B-55-4. *Foster Wheeler Corporation, 165 Broadway, New York 6, New York.*

OTHER FEATURES AT A GLANCE

- Completely water-cooled walls
- Unrestricted circulation
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- Efficient convection surface
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BOILERS...FURNACES...KILNS...DIRECT-FIRED HEATERS, ETC.

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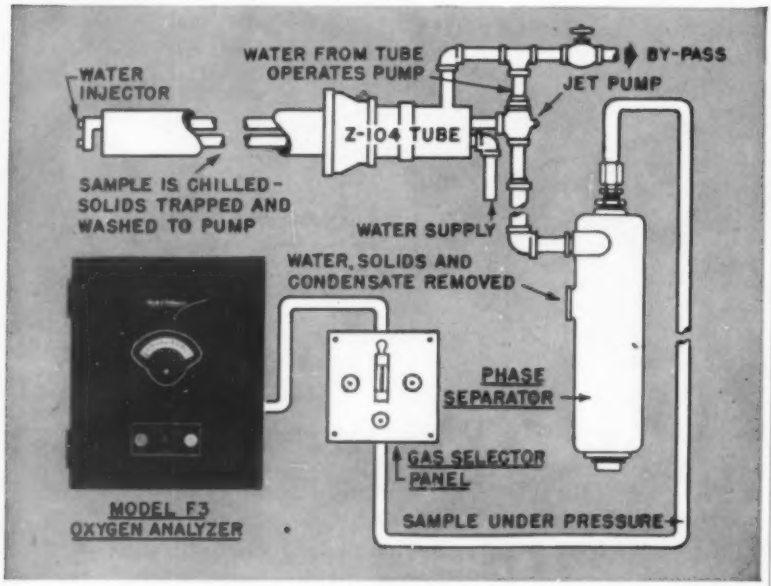
complete Analysis Systems!

Arnold O. Beckman, Inc. – leaders in developing advanced instrumentation for accurate oxygen control – now offers *complete* analysis systems for higher combustion efficiencies at lower fuel costs.

These field-proven systems are already being used by progressive operators to boost profits, cut costs – and they will make the same savings for *you.* They consist of Analyzer, and Sampling System – all in one compact installation suitable for indoor or outdoor location. For severe temperature conditions, heated cabinets can be supplied.



The diagram (above) shows a typical analysis system for boilers. The incoming sample gas is first chilled and washed . . . then passes through a Separator where the condensables and solids are removed. The resulting clean, dry sample gas flows under pressure to the Gas Selector Panel (for selecting "Zero," "Span" and "Sample" gases) . . . then into the Analyzer where the oxygen content is quickly measured. The Analyzer may be used with any standard recorder or controller.

Result – new speed, simplicity and accuracy in controlling air-fuel ratios, with important savings in fuel and operating costs!

Get the full story on these Complete Analysis Systems by writing for Data File #19D-76.

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this process for today's power plants. Developments, trends and applications of both multi-bed and mixed-bed ion exchange are considered, and several case histories cited. A comprehensive bibliography lists 119 separate items. Tables, flow sheets, descriptive drawings, performance curves, process selection charts included. Graver Water Conditioning Co.

161 Deaerating Heater Unit — Technical Reprint T-149, on a shop-built deaerating heater for the smaller plant, tells why the unit was developed and gives details of construction. Illustrated with photos, this article includes information on sizes, dimensions and space requirements. Graver Water Conditioning Co.

162 Industrial Filters — How industrial filters can lower production costs is the theme of 10-pp Bulletin 651. Several simple case histories — from filtering city water to the filtering of recirculation water from cooling towers and spray ponds — are cited. Company's IWF filters are featured, including sectional views, typical installation drawings, dimension charts and diagrams. R. P. Adams Co., Inc.

NOZZLES

163 Steam-Activated Nozzles — Bulletin Supplement 3A describes sparger nozzles, direct contact steam jet devices designed for submergence in liquids to be heated. Literature supplements a previously issued Bulletin 3A on steam jet heaters for liquids. Application, construction, operation, installation, and sizes are covered. Schutte and Koerting Co.

164 Spray Nozzles — Twenty-pp Catalog I, new edition of company's industrial spray nozzle catalog, contains expanded capacity charts and information on previous standard items, and lists new ones. Fully illustrated, covers atomizing, nonclog, large capacity, gas scrubbing, flat spray, solid spray, special core nozzles and others, as well as strainers, pressure regulating valves and oil burner nozzles. Specifications and application suggestions are included. Monarch Mfg. Works Inc.

OTHER EQUIPMENT

165 High Speed Turbines — Bulletin GEA-6232, 28 pp, describes mechanical drive turbines, operating at speeds ranging up to 10,000 rpm and above. Construction and design features of turbines for centrifugal compressors and blowers are covered, and cross sections, schematic drawings, cutaways, and typical installation photos point out design features and applications. Operation and arrangement of the governing system for close speed control is also discussed and steam rate tables and curves are included. General Electric Co.

166 Filter Underdrains — Information on filter underdrains and underdrain blocks is presented in two new bulletins. No. 901-B, 8 pp, describes the primary and secondary distributing system, typical installations, performance and specifications. Bulletin 6220-B covers various types of filter underdrain blocks. Infilco Inc.

167 Acidizing Service—Advantages of company's acidizing service for water wells designed to increase water yield by enlarging formation channels and by removing scale deposits from pumps and screens are detailed in this informative bulletin. Case histories of successful applications are featured. Dowell Inc.

NUCLEAR NEWS FROM ATOMICS INTERNATIONAL

Industry's First Private Research Reactor Now in Operation

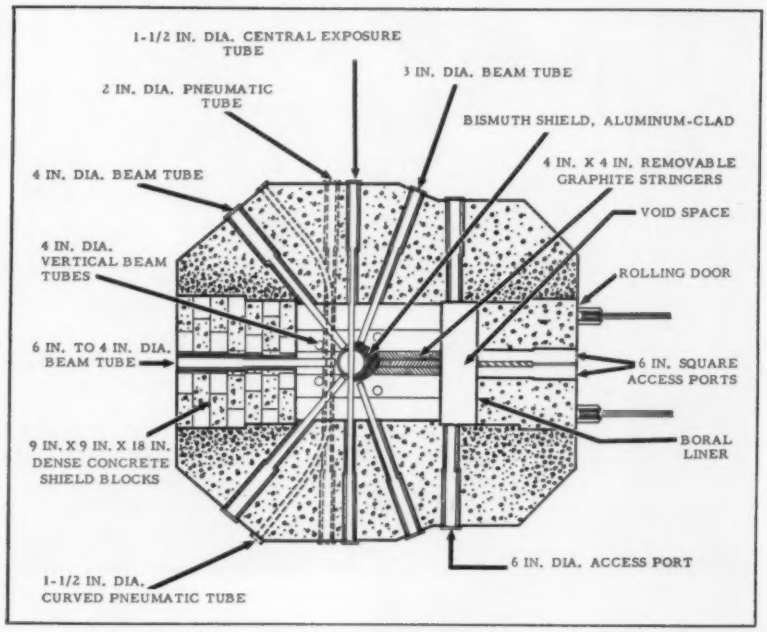
The Armour Research Foundation's nuclear reactor, located on the Illinois Institute of Technology Campus on State Street near Chicago's Loop, began operating early this spring. This marked the first time that private industry has had at its disposal a nuclear reactor expressly designed for industrial research.

Already under way at Armour are programs by participating companies, taking advantage of the revolutionary research techniques made possible by the new facility. The schedule includes allocation of reactor "time" for private studies, free of security restrictions. Areas of study include: food and drug processing; materials research – glass, ceramics, plastics, rubber, textiles, etc; petroleum, chemicals and other industrial materials and processes.

The Model L8 Armour reactor is of the homogeneous solution type, designed to operate at 50 KW and to produce a maximum thermal neutron flux of about 1.7×10^{12} neutrons/cm^2-sec at the center of the reactor core. Exposure facilities are provided through which the neutron flux is available in varying intensities for experimental purposes. Power level is controlled either manually or automatically by a vertical control-rod system. The reactor is safeguarded by a unique control system which "scrams," or automatically shuts down the reactor, if necessary.

One of several reactors produced by ATOMICS INTERNATIONAL, a Division of North American Aviation, Inc., the design and construction of the L8 Model is based on the company's 10 years' experience in the development of peaceful applications of nuclear energy. Other applications include a reactor designed for a prominent southern California university, specially adapted for cancer and other medical research; the important Sodium Reactor Experiment in the Santa Susana Mountains near Los Angeles, part of the AEC program to develop economical power from nuclear energy; plus development and design of a 75,000 KW sodium-graphite nuclear power plant.

ATOMICS INTERNATIONAL is a major reactor builder—experienced in the design, construction and operation of nuclear reactors for research and the production of power.


1-1/2 IN. DIA. CENTRAL EXPOSURE TUBE
3 IN. DIA. BEAM TUBE
2 IN. DIA. PNEUMATIC TUBE
BISMUTH SHIELD, ALUMINUM-CLAD
4 IN. X 4 IN. REMOVABLE GRAPHITE STRINGERS
4 IN. DIA. BEAM TUBE
VOID SPACE
4 IN. DIA. VERTICAL BEAM TUBES
ROLLING DOOR
6 IN. TO 4 IN. DIA. BEAM TUBE
6 IN. SQUARE ACCESS PORTS
9 IN. X 9 IN. X 18 IN. DENSE CONCRETE SHIELD BLOCKS
BORAL LINER
6 IN. DIA. ACCESS PORT
1-1/2 IN. DIA. CURVED PNEUMATIC TUBE

Reactor Plan View

ARMOUR RESEARCH REACTOR MODEL L8

Characteristics

Design Power	50 kw
Zero Power Critical Mass*	850 gm U^{235}
Maximum Thermal Neutron Flux	1.7×10^{12}n/cm^2-sec
Mass Coefficient of Reactivity*	0.03%/gm
Temperature Coefficient of Reactivity*	—0.029%/°C
Fuel Solution Temperature at 50 kw*	80° C
Excess Reactivity at 20° C, Zero Power*	3%
Reactivity Held in Control and Safety Rods*	8% (2% each rod)
H : U^{235} Atomic Ratio*	350
U^{235} Concentration*	75gm/liter
Power Density, Maximum	5.5 watt/cm^3
Power Density, Average	3.85 watt/cm^3

Approximate Value

Brief General Description—The reactor fuel is a light water solution of UO_2SO_4, enriched in U^{235}. This fuel is contained in a spherical stainless steel core tank, which is surrounded by a graphite reflector. The reactor is shielded with high density concrete (density 3.5 gm/cm^3) plus other selected materials. Fuel-handling, gas-handling and cooling systems are provided; also complete instrumentation and equipment are installed for remote operation and to provide automatic safety action.

Experimental Facilities—The experimental facilities include nine assorted beam tubes, 3" to 6" ID; straight and curved pneumatic tubes, 1½" and 2" ID; central exposure tube; horizontal thermal column 5' square, with four 6" access ports. In addition there are special exposure facilities which make use of the gamma activities in the reactor atmosphere.

If you are interested in any phase of our activities, ATOMICS INTERNATIONAL is staffed and equipped to help you. Please write: Applications Engineering Service, Dept. PE-N3, ATOMICS INTERNATIONAL, P. O. Box 309, Canoga Park, California. Cable address: ATOMICS.

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PIONEERS IN THE CREATIVE USE OF THE ATOM

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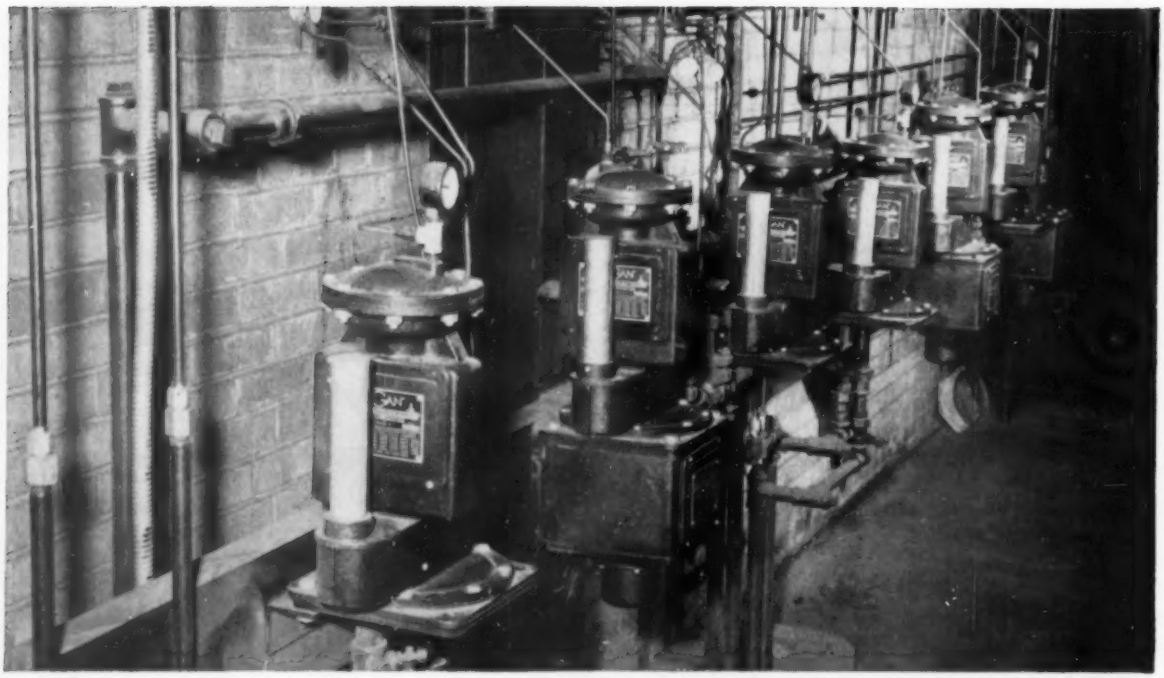


Gas flow, air flow and coal flow regulators and transmitters at Weirton Boiler No. 5

Hagan automatic combustion controls at Weirton plant

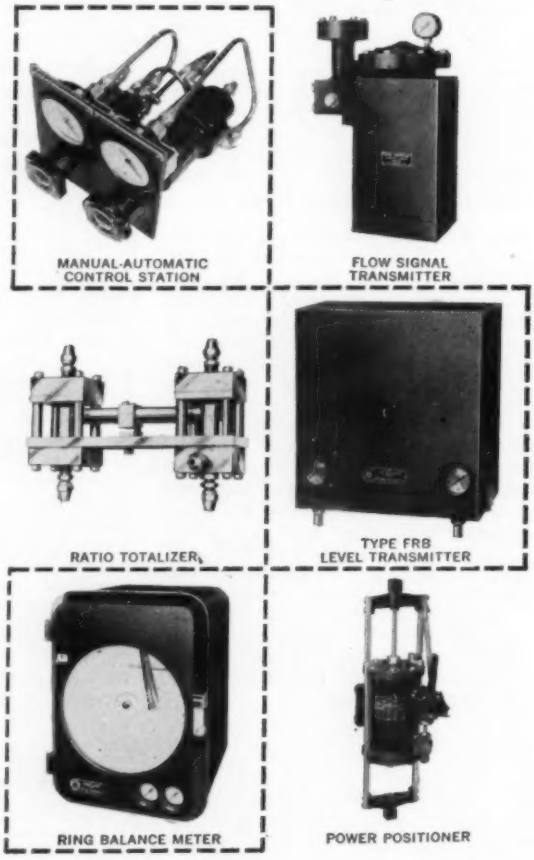
The Hagan systems on Boiler No. 5 at the Weirton Plant of the Weirton Steel Company include Automatic Combustion Control for triple-fuel firing, Three-Element Boiler Feedwater Control and Pressure Control Systems for blast furnace and coke oven gas. The remote manual switching employed for the regulation of the induced draft fan is an exclusive Hagan development* which adds to the over-all system efficiency by eliminating long transmission lines and speeding control response.

Hagan engineering skill has made possible many advances in fuel burning practices, and has resulted in system component designs which are versatile, accurate and extremely reliable.

These Hagan instrumentation and control units are available as separate components. They are invaluable aids to the engineer who wishes to design solutions to his own control and metering problems.

For details on Hagan systems or components, see your Hagan engineer or write for descriptive bulletins.

*U.S. Patent 2719535.



HAGAN CORPORATION

HAGAN BUILDING, PITTSBURGH 30, PA.

Systems and components for: Process Control, Boiler Combustion Control, Metallurgical Furnace Control, Aeronautical Testing Facilities • Industrial Water Treatment • Chemical Water Conditioning

SUBSIDIARIES: CALGON, INC. • HALL LABORATORIES, INC.

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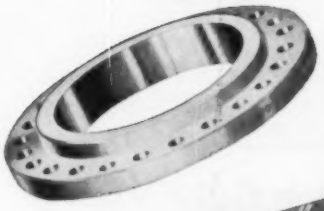

Craftsmanship in steelmaking, forging and machining assures quality in the ALCO flange.

The ALCO flange is produced of high-quality carbon or alloy steel, made in ALCO's own furnaces. Steel production by the flange manufacturer lowers your welding, preheat and postheat costs because exact metallurgy is assured.

Forging and rolling techniques, drawn from ALCO's extensive experience, increase the quality of the ALCO flange. Metallurgical laboratories check metal characteristics through every step of flange production.

Finish and tolerances on the ALCO flange are provided by skilled machinists. You get flanges that fit right, work right in the job you assign to them.

The ALCO flange is available in a wide range of metallurgies to almost any specification. Fast delivery and prompt service on standard flanges are available from two locations, Beaumont, Texas and Latrobe, Pa. Sizes range from 18 in. up.

Contact your nearest ALCO Sales Office or write P.O. Box 1065, Schenectady 1, New York, for your copy of ALCO's 54-page catalog on Flanges and Welding Fittings.

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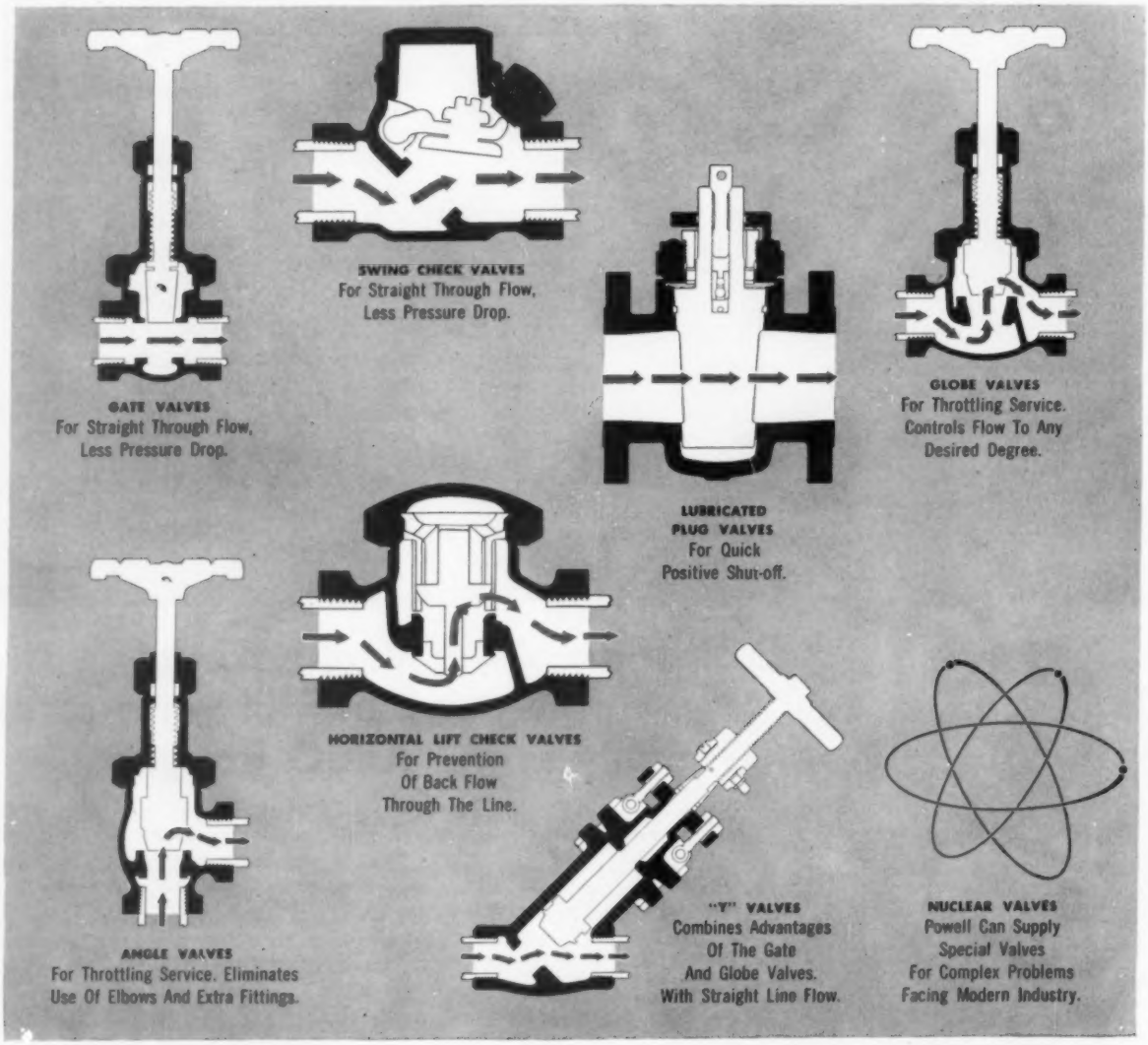
POWELL
for all valve needs



for every flow control problem there is a right Valve

Powell can supply this right valve—*made right* of the right material*. Every part of every valve must pass rigid inspection. And as a final step in manufacture, every Powell Valve has *Performance Verified* through an *actual line test.*

As an aid in selecting the right valve, the basic valve designs are illustrated here. For complete information on the wide range of sizes and materials available in each type of the basic valves illustrated above, consult your Powell Valve distributor. If none is located near you—or if you have a special flow control problem—write direct to The Wm. Powell Company, Cincinnati 22, Ohio.

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POWELL VALVES

*BRONZE, IRON, STEEL AND CORROSION RESISTANT VALVES.

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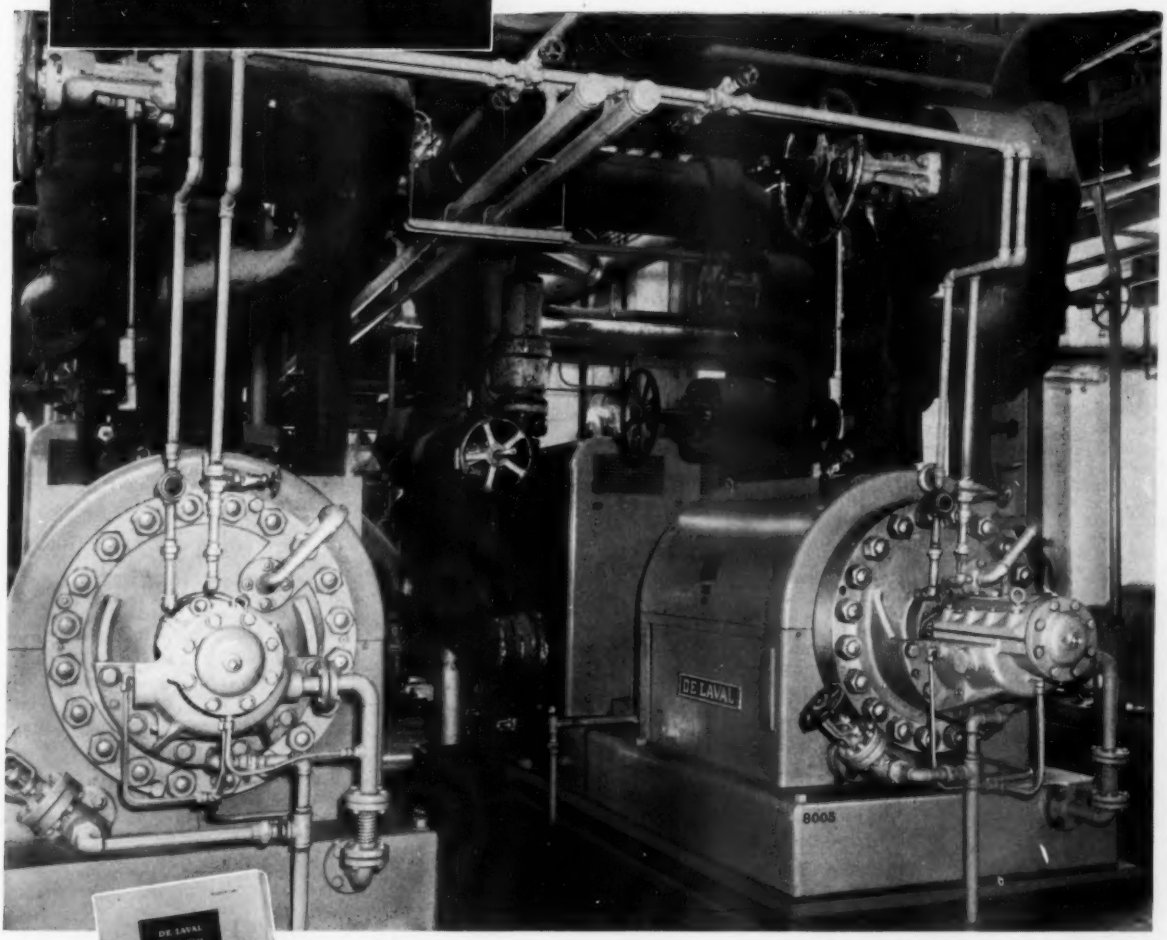
DE LAVAL
BARREL TYPE BOILER FEED PUMPS

give dependable service at Gaylord Container



Bulletin contains helpful data

Bulletin 1506 on the De Laval barrel type boiler feed pump covers all major design points... has cross-section cutaway illustration for easy reference. Write for your copy.

Here's additional proof of De Laval reliability on the line in the Bogalusa, La. plant of the Gaylord Container Corporation. These two De Laval barrel type boiler feed pumps are both driven by De Laval MCP turbines operating at 850 psi, with steam temperature at 825 F.

• De Laval barrel type boiler feed pumps are widely used by industrial plants and public utilities. They operate at pressures up to 5,500 psi. These units offer many important design advantages, such as double volute diaphragm, individual diaphragm bolting, positive sealing between suction and discharge chamber and bare shaft construction. Their dependability is proven by year-in, year-out service.

DE LAVAL *Boiler Feed Pumps*

DE LAVAL STEAM TURBINE COMPANY

816 Nottingham Way, Trenton 2, New Jersey

DL 920

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CONSTRUCTION NEWS

Crockett, Calif. — The California & Hawaiian Sugar Refining Corp., Ltd., 215 Market St., San Francisco, Calif., has authorized plans to include a steam power house installation at local plant here, in conjunction with major plant expansion. Project will comprise several large structures and is reported to cost in excess of $6,000,000. Bechtel Corp., 612 S. Flower St., Los Angeles, Calif., are consulting engineers. It is estimated that the steam power installation will cost approximately $3,500,000.

Grand Junction, Colo. — The Public Service Co., Gas & Electric Building, Denver, Colo., has awarded a contract to Stearns & Rogers, 660 Bannock St., Denver, Colo., to design and construct a new steam-electric generating plant with an initial capacity of 22,000-kw. Plant when completed will represent an investment of $4,500,000.

Lake City, Fla. — Voters of this city rejected by a 3 to 1 margin, a recent proposal that the city purchase the existing electric facilities of the Florida Power & Light Co. here. The project would have provided the city with a municipal power system at a cost of between $3,000,000 and $5,000,000, including construction of a city owned generating plant.

Peoria, Ill. — The Central Illinois Light Co. has plans under way for the financing of stock and bond issues to realize a construction budget of approximately $26,000,000. Company plans to spend about $69,000,000 during the five year period ending in 1960. Central Illinois Light plans to spend $18,000,000 in 1956; $17,000,000 in 1957; $9,000,000 in 1958; a like amount in 1959 and $16,000,000 in 1960.

Rock Island, Ill. — The Iowa-Illinois Gas & Electric Co., has announced plans for major expansion of company facilities and plans to spend in the next three year period an amount estimated at about $30,000,000, on new construction. Company will begin financing through banks to cover cost of expansion and plans permanent financing in 1957 to pay back loans and cover cost of future construction. Company is currently negotiating electric and gas rate increases in the area which it serves.

New Albany, Ind. — The Public Service Company of Indiana, 1100 Main St., Plainfield, Ind., has plans maturing for the installation of new power plant at local site. Contract for the construction of sub-structure and power house building has been awarded to G. K. Newberg Construction Co., 2040 N. Ashland Ave., Chicago, Ill., and work is expected to get under way at once. Total estimate when plant is completed to run about $47,000,000.

Somerset, Mass. — The Montaup Electric Co., jointly owned by Blackstone Valley Gas & Electric Co., Brockton Edison Co., and Fall River Electric Light Co., all subsidiaries of the Eastern Utilities Associates, has announced plans for the construction of a 100,000-kw steam-electric generating unit to be added to the Somerset plant. Unit will be in operation in late 1959 and will give local station a total capacity of 300,000 kw. Plant will be erected at an estimated cost of $19,500,000.

Jackson, Mich. — The Consumers Power Co., has announced plans for the construction of the first unit of a new power plant, adjacent to company's present facilities at the mouth of the Saginaw River, known as the John C. Weadock power station. Plant site is presently under water and will require extensive fill operations before construction begins. Work on initial 250,000-kw unit is expected to get under way this summer for completion in mid-1959. Company plans to have 1,700,000 kw of generating capacity at site ultimately, — which is more than present capacity of entire system. Plans project cost of plant when completed at more than $100,000,000.

Duluth, Minn. — The Minnesota Power & Light Co., 30 West Superior St., is said to have preliminary plans under advisement for new steam-electric generating plant on site near here. New installation is expected to cost an estimated $12,000,000, and will have a rated capacity of 65,000-kw. New power plant is now being scheduled for operation late in 1958.

St. Louis, Mo. — The Union Electric Company of Missouri, has arranged for financing in the amount of $18,000,000, fund to be used in current construction program, including increased generating facilities, transmission lines, power substations.

New York, N. Y. — The American Gas & Electric Co., has preliminary plans under way for the construction of two new steam-electric generators for subsidiary operations, — each with a capacity of 450,000-kw. Units will be 73% larger than any single unit in operation anywhere in the world and will develop the equivalent of more than 600,000 horsepower, enough to supply residential electric requirements for a city with a population of 4,000,000. Exact location has not as yet been determined but will be installed in two of the systems three biggest operating subsidiaries: Appalachian Electric Power Co., The Ohio Power Co., or Indiana & Michigan Electric Co. Each generating unit will cost in excess of $50,000,000.

Charlotte, N. C. — The Duke Power Co., 422 S. Church St., is arranging financing and is planning to dispose of a bond issue of $30,000,000, portion of which is to be used in connection with current construction program covering power plants, transmission lines and other operating facilities. Present construction program calls for an expenditure approximating $100,000,000 for the two year period ending in 1957.

Raleigh, N. C. — The Carolina Power & Light Co., has authorized plans for the expenditure of approximately $40,500,000, for construction, expansion and modernization over the next two years. Program includes completion of a 180,000 horsepower generating unit near Moncure by mid-year, and plans for an additional generating unit by mid-1958. By comparison, the 1958 unit will have a capacity of 225,000 horsepower. The company's 1956 budget for new construction will total approximately $20,300,000, part of an anticipated construction of the next three years of $65,000,000.

Toledo, Ohio — The Toledo Edison Company, Edison Building, has authorized expenditure of $4,700,000 for improvement and extension of company transmission lines and substation facilities, to supply new customers and give additional capacity to growing industrial and commercial areas. A new 138,000 volt circuit on 57-mi high tension line from Lemoyne to Defiance, Ohio, will be added with necessary substation facilities at a cost of $1,100,000.

Medford, Ore. — The California Oregon Power Co., 216 W. Main St., has arranged for financing in the amount of $7,000,000, proceeds of which will be used in connection with construction and expansion program for 1956. Work will include property additions, general improvements, increased generating facilities, transmission lines and other work.

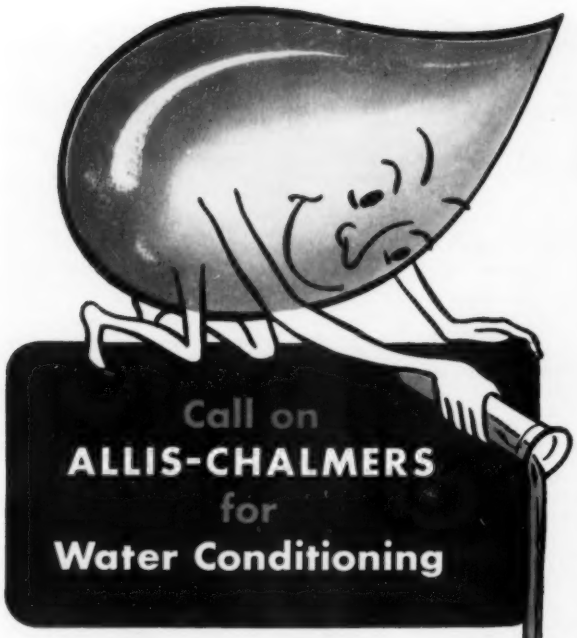
Newcastle, Penna. — The Pennsylvania Power Co., 19 East Washington St., Newcastle, Penna., has authorized plans and work is already under way on the installation of a new steam-electric generating unit. This will be the fourth installation at the Newcastle Power Plant. Cost of the Power plant and building installation when completed is estimated at $17,500,000. The Foundation Company, 57 William Street, New York 5, N. Y., is engineer.

Bryan, Tex. — The City of Bryan, Tex., has plans maturing for proposed improvements to municipal electric generating plant to increase capacity. Work will include increased generating capacity, transmission lines and miscellaneous improvements. Cost of improvements when completed estimated at $2,000,000.

Salt Lake City, Utah — The Utah Power & Light Co., has filed with the Securities and Exchange Commission for permission to borrow an amount estimated at $25,000,000 from banks. Company plans to sell additional securities in 1957, to finance repayment of these loans and for additional expansion. Utility estimates its construction expenditures for 1956 and 1957 at $41,000,000.

Milwaukee, Wis. — The Wisconsin Electric Power Co., Public Service Building, has arranged for the sale of bond issue in the amount of $30,000,000, to help finance its construction program. A considerable portion of the fund is to be used for the extension and improvement in power generating facilities, including transmission lines, power substations and other operating facilities.

Milwaukee, Wis. — The Wisconsin Public Service Corp., has arranged an expansion and improvement program over a 12-mo. period to cost in excess of $7,882,000. Power plant expenditures will exceed the $1,000,000 mark, consisting of a cooling water intake tunnel and the start of a new generator at the Pulliam steam-electric plant at Green Bay, Wis. This new unit will have a capacity of 75,000-kw and will ultimately cost about $12,000,000, over the next three year period. An additional $430,000 will go toward improving and extending electric transmission lines and an amount of $830,000 for new substations and additions and improvements to existing ones.



Kill Algae

NEW, easy, low-cost way

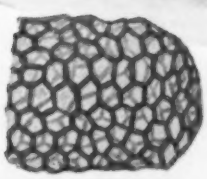
New Allis-Chalmers No. 120 Series Algaecide most toxic to all organisms in cooling towers

Many toxic materials used as algaecides are either difficult to handle (as in chlorination) or are effective against certain organisms, but not others. Fouling of cooling tower systems by algae and slimes results.

New No. 120 Series Algaecide succeeds when copper sulfate, potassium permanganate, quaternary ammonium compounds, sodium pentachlorophenate, and other complex chemicals offer only a partial solution to fouling conditions.

For complete information, call your A-C office, or write Allis-Chalmers, Power Equipment Division, Milwaukee 1, Wisconsin, for Bulletin 28X8434.

As little as 2 ppm has killed all these algae

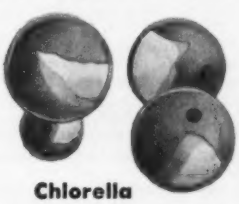


Hydrodictyon

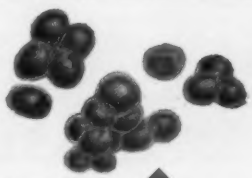
Microcystis

Anabaena

Oocystis



Chlorella



Protococcus

ALLIS-CHALMERS

A-5101

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EQUIPMENT NEWS

Described on these pages are new and improved products. Use Reader Service Cards on pages 113–114 to ask for more information on them. Just circle the item numbers of all the products in which you are interested.

1—MARINE GENERATOR gives more steam in less space

This dry land adaptation of company's marine steam generator is claimed to make it possible to obtain 5000 lb steam/hour from an overall floor area of 8 by 7 ft. This can mean 150 hp in less than half the space required for many packaged steam generators. The boiler is designed to modulate over a wide range with high efficiency. It is electronically controlled. Oil pump assembly is furnished factory-installed under the unit. Water treatment tanks are mounted on side of the boiler shell, piped to feedwater pump system. Bypass piping permits manual water circulation control. Cyclotherm.

2—DEODORIZER for use with air conditioning systems

Eastonair evaporates when placed in a moving air stream, manufacturer states, and liberates neutralizers to eliminate disagreeable odors often found in air conditioning systems. It is also said to freshen stale air without imparting a new odor to the system. According to manufacturer, this deodorant contains no vegetable dyes, and no chemical agents that deaden the sense of smell; it does contain a synthesized chemical agent that is non-toxic and non-irritating; and it does not require reactivation. Eastonair comes in 1-lb jars, 5- and 10-lb cans. No special apparatus or duct openings are required for installation, it is noted, and there is no danger of spilling or corrosion. Easton R. S. Corp.

4—DUCT INSULATION made of spun mineral wool

Felted from longer, finer spun mineral wool fibers, this semi-rigid duct insulation is available in three types: plain; with an integral vapor barrier for use on duct exteriors; and Neoprene coated, for duct interiors. Manufacturer says the Underwriters' label has been applied for on both the plain and Neoprene coated types. This new insulation is not irritating to handle, it is noted, and can be cut with a knife to conform to irregularly shaped or curved surfaces. Composed of non-cellular, spun mineral wool, the material does not absorb moisture. When applied where condensation is a problem, the vapor type should be used. The insulation may be applied by currently acceptable methods. It comes in 24-by-48 in. sheets in thicknesses of ¾, 1, 1½ and 2 in. It is designed to withstand temperatures to 450 F. Baldwin-Hill Co.

5—ROTARY OIL BURNERS with integral air registers

Ranging in size from 9 to 125 gph, these burners are reported to combine advantages of company's rotary oil burner with unusual ease of installation. They will fire with No. 6 or lighter oil, and are designed for natural or induced draft with approximately 0.10 to 0.15 in. WC required for full rating. The integral air register is claimed to assure maximum combustion efficiency over a wide firing range. Combustion air is introduced through the firing port, facilitating thorough mixing of oil and air and cutting excess air to a minimum. No checker floor for introducing secondary air is needed, company notes, since it is introduced through the air register.

Burner is shipped in two sections: burner proper, and air register. The two units may be bolted together on the job. A modulating type automatic actuator is used to provide proper amount of fuel and air to maintain desired water temperature or steam pressure. Primary combustion air is supplied by the burner fan: secondary air is introduced through the air register. Electronic safety controls provided. Iron Fireman Mfg. Co.

6—SHADED POLE MOTOR in 1/15 through 1/10 hp ratings

This totally enclosed, shaded pole motor, for high output applications such as ceiling hung gas fired unit heaters, has a "sealed-in" lubrication system and is reported to require no reoiling or service under normal use. Available in ratings from 1/15 through 1/10 hp, this 39-frame motor has a 5½-in. diam. A special "oil pump" groove on the motor's shaft serves to provide continuous replacement of cooled, filtered oil on bearing surfaces. Dual oil impervious slingers help to seal-in recirculating lubricant, reducing service requirements on motors mounted in hard-to-reach locations. General Electric Co.

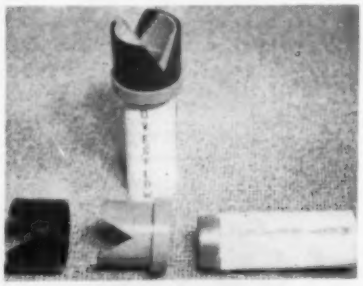
7—CANTILEVER-TYPE SUPPORT for cable trough

A twist of the wrist is claimed all that is necessary to secure the Rakit arms to which the expanded metal cable trough is bolted. Arms themselves are secured

to up-right channel irons with prepunched holes that provide a wide number of possible settings. Cantilever type arm is popular for the support of cable trough, company points out, as the cable can be lifted in over the side of the trough without any interference from the up-rights which support the arm itself. T. J. Cope, Inc.

8—CONTROL DEVICE for cooling tower bleed-off

The V-Notch Weir is described as a simple device for easy adjustment and control of bleed-off in cooling towers and evaporative condensers. It is designed to provide variable bleed-off for

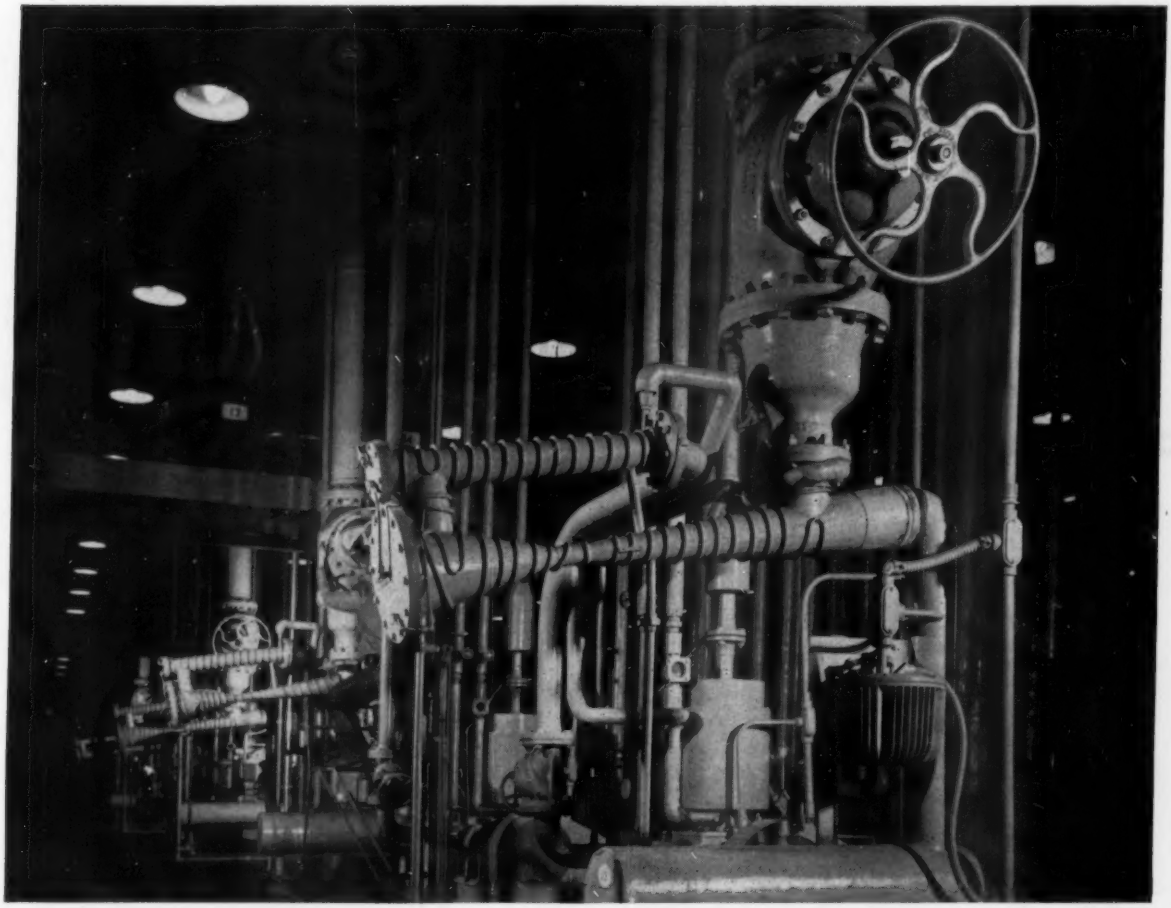


control of concentrations and also to act as a skimmer for removal of suspended solids and such surface trash as dead algae and slime. Scale deposition and corrosion are reduced and controlled by controlling the concentrations and using properly formulated chemical treatment. The V-Notch Weir is easy to install, manufacturer states; it is mounted by simply cutting and threading the overflow pipe so that the assembled height,

3—WATER COOLER is versatile packaged unit

Described as a complete package plant on wheels, this portable water-cooling tower is expected to relieve situations in which limited cooling water supplies retard production. It may answer a need in small chemical plants, in small diesel power stations with large volumes of water to recirculate, and even in air conditioned buildings. It is now being used in conjunction with portable oxygen-generating plants in remote locations. Compact and lightweight, it has all necessary accessories — pumps, strainers, electrical control equipment, pressure gages, thermometers and feedwater conditioner.

The tower pictured is of steel packed with 20-in. Fiberglas and having an entrainment separator of copper mesh. The four axial fans have a capacity of 11,000 cfm each. Its design capacity is 240 gpm of 115 F water reduced to 90 F when the unit is operating at 95 F air temperature. Badger Mfg. Co.



These Crane valves holding 25 microns absolute pressure after 2 years on vacuum service

The Case History—Valves frequently are the most critical points in a vacuum system. But that's not the case with this large Southern light metals refiner.

This plant reports no trouble or expense over a 2-year period in maintaining a vacuum of less than 25 microns absolute for its distillation process.

The tight-holding valves installed about 2 years ago on the lines from vacuum pumps shown above are Crane No. 1611 diaphragm pattern. These 12-in. packless iron body valves are used about once daily.

They've allowed no in-leakage at the seat, bonnet-joint, or through the diaphragm. No maintenance whatever has been given the valves since installed. They operate easily and look good for such service indefinitely.

This high efficiency performance is mainly due to Crane separate disc and diaphragm design. The diaphragm used as a bonnet seal only is not subject to destructive crushing. Conventional type disc and body seat provide a metal-to-Neoprene seating that's ideal for vacuum and hard-to-hold fluids.

Moderately priced, Crane diaphragm valves deserve your consideration for many ordinary services, as well as sludges, slurries and corrosive fluids. They are made in a wide variety of body and trim materials, in ½ to 12 in. sizes.

Ask your local Crane Representative about them, or write to address below for literature.

CRANE VALVES & FITTINGS

PIPE • KITCHENS • PLUMBING • HEATING

Since 1855—Crane Co., General Offices: Chicago 5—Local Service Everywhere Through Branches & Wholesalers

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with the weir, will be the same as the original overflow pipe. The volume of bleed-off is controlled by turning the sleeve fitting, thereby adjusting the depth of V-Notch. The unit is made of Saran plastic. Deady Chemical Co.

9—HYDRAULIC RELAY features high frequency response

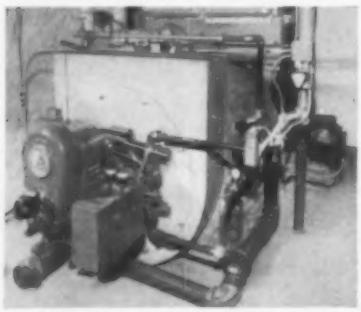
Announced as a high precision tool, capable of high frequency response, this hydraulic relay may be installed in any position and requires no adjustment. It is described as simple, compact, rugged, leak proof and completely sealed. Standard unit may be operated at hydraulic pressures to 750 psi without use of auxiliary devices. Any metering device that produces a signal force in the magnitude of a few grams, and is proportional to deviation, makes of the relay a powerful automatic hydraulic control for the metered circumstance. Relay is available as a component, or it will be furnished with complete signal systems, pump units and accessories for specific automatic control applications such as web guide, speed, pressure, flow, voltage, current, position. Hague Regulator Corp.

10—BATTERIES with higher instantaneous discharge

These new Exide-Manchex Batteries, in heat-resistant polystyrene jars, are designed for stationary power applications in utility, industrial plants and other operations. They retain the basic Planté positive plate, a feature of all Exide-Manchex Batteries. Major improvements are announced as providing for increased battery life; higher instantaneous discharge rates; reduced maintenance because of less frequent additions of water, more effective sealing and easier cleaning; adaptability to cycle or float service. Exide Industrial Div., The Electric Storage Battery Co.

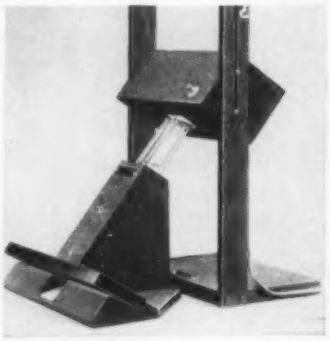
11—WATER-WALL FURNACE steps up boiler capacity

This water-wall furnace is being offered for incorporation with user's standard burner equipment for installation on existing boilers. It will also be made available along with a horizontal rotary oil burner, as part of company's packaged automatic Thermopak Combustion System. According to manufacturer, the basic advantages this water-wall brings to an existing boiler are: improved circulating characteristics of the boiler; longer life expectancy of existing boiler equipment; greater efficiency; reduction in combustion chamber maintenance. Preferred Utilities Mfg. Corp.



12—WATER ANALYZER indicates hydrazine value

For use where hydrazine is used as an oxygen scavenger in industrial plant boilers, the Hydrazine Comparator is reported to offer a simple adequate method of analysis. It is a water analyzer with a slide containing permanent hydrazine



standards for nine values from 0.00 to 0.30 ppm of hydrazine (N_2H_4). A test is made by placing 50 ml of the sample in a small (2 oz) glass-stoppered bottle with minimum exposure to air and adding 2.5 ml of hydrazine reagent. After mixing, the sealed test sample is allowed to stand 30 min before reading. Previous to this time, two water analyzer tubes have been filled to the mark with water being tested and placed in the outside compartments of the base. The treated sample is transferred to the third tube (to the mark) and placed in the middle compartment. The slide is moved as required and colors observed in the mirror until a color match is obtained. Hydrazine value is then read directly from slide. W. A. Taylor & Co.

13—CIRCUIT BREAKER for combination starters

This smaller "E" frame circuit breaker is now standard on all of company's combination starters, with breakers rated 250-v, 100-amp. The new design and also the 600-v form now include provision for using the same type of handle mechanism currently used on combination starters with a disconnect switch. This mechanism mounts directly on the breaker. Announced as meeting JIC specifications, this circuit breaker form of combination starter is engineered so that the starter handle can be padlocked only in the off position. Now in production, the "E" frame breaker has an interrupting capacity of 7500 amp and will be supplied on company's CR 7008 combination starters, CR 7010 combination reversing starters, and CR 7108 combination multi-speed starters in sizes O-3. General Electric Co.

14—SMALL VALVE regulates, reduces pressure

Only 5⅝ in. high and 2⅝ in. face-to-face, the Type 3381 is announced for pressure control of air, water, oil, steam and most liquids and gases. Body and trim are bronze; seat and diaphragm are bronze or composition. Sizes are ¼ and ⅜ in., with screwed ends; a ½-in. size may be ordered. The Type 3381 Valve operates at inlet pressure to 400 psi at 150 F, and 250 psi at 400 F. Fire spring ranges are available from 5 to 300 psi delivery pressure. The valve can be supplied with a pressure gage, mounted in either of the two outlet connections. Adjusting screws are available with square head, plastic knob or wing nut. The Type 3381 is a refinement of company's older Type 3380 Valve. Improvements announced include: elimination of cap screws for easier maintenance; and increased spring length for greater sensitivity and improved regulation. Bulletin 948 gives data. A. W. Cash Co.

15—PIPE COMPOUND, Teflon based, seals corrosives

John Crane Chemlon Pipe Joint Compound will seal practically all known highly corrosive liquids and solvents, manufacturer states. This chemically inert material has a base of duPont Teflon, and is claimed impervious to all types of hard-to-handle fluids and to possess an extremely low coefficient of friction. The latter substantially reduces wrench torque, it is noted, permitting connections to be drawn up to a greater degree of tightness without undue stress or strain. The non-adhesive quality of Teflon and non-hardening characteristics of the compound allow the connections to be readily disassembled, even after long, severe service, according to company. The compound is suggested for use on aluminum, stainless, Monel, or plastic pipe; it comes in 2-oz jars. Crane Packing Co.

16—HANDY TWEEZER works where space is limited

Although intended for electronics and electrical work, the Tension Tweezie is suggested for mechanics and others

working in restricted areas. It is a long pointed tweezer designed to reach into cramped quarters and hold the smallest electronic parts; the tension feature lets it hold the part without finger interference or pressure. Hunter Tools.

17—HYDRAULIC GOVERNOR with higher work capacity

Class 3300 Hydraulic Governor features full work capacity with complete regulation over the full range of speed settings for constant speed governors. Its rated work is 123 in.-lb, rated torque is 159 lb-in., and steady state stability is claimed better than 0.1 per cent. Isochronous or speed-droop characteristics are obtainable by manual adjustment. Adjustments provided include speed changer, steady state speed regulation, first compensation relay, second compensation timing valve, rate of response and load limit throttling. A fail-safe

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"Prescriptions" by the truckload!

Solving industrial water conditioning problems effectively and *economically* requires exacting engineering techniques.

There are no stock answers . . . no stock chemical treatments.

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A 20-minute, no obligation discussion of your plant water problems with a Betz District Engineer is the best investment in time you can make. Call him in today.

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CONSULTANTS ON INDUSTRIAL WATER PROBLEMS

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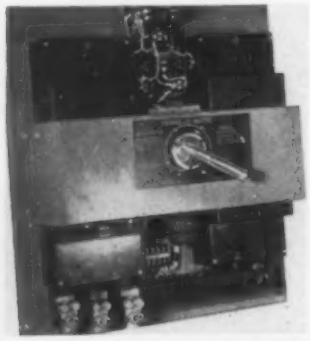
flexible drive serves to dampen speed variations without affecting performance. Simplified construction permits easy assembly and maintenance, company adds, with no special tools required. All parts are interchangeable in field. Industry standard or custom mountings are included. Farris Pickering Governor Co., Inc.

18—TRANSFER SWITCH has mechanically linked breakers

For use with emergency power and light systems in hospitals, industrial and power plants, and processing operations where continuity of service is vital, the Trans-O-Matic is an automatic transfer switch utilizing mechanically linked circuit breakers as the interrupting element. Available in capacities to 600 v, 800 amps, with interrupting capacities to 50,000 amps rms, the circuit breaker



elements are designed to take inductive inrush currents of incandescent lamps of up to 20 times normal full load ratings.

There are only two possible switch positions: normal closed, emergency open; normal open, emergency closed. No neutral position is possible, according to manufacturer, due to the double-throw design of the interruptor linkage. Trans-O-Matic Switches can be provided with either total failure or partial (phase) failure protection. The former transfers load to emergency source only upon failure in all legs of a single phase or in all phases of a multiple phase normal source. With this design, return transfer to normal takes place when 70 per cent voltage is restored. Partial failure protection provides transfer upon a voltage failure in one leg only of a single phase, three-wire system and in one phase only of a multiple phase system. Return transfer is delayed until restoration of 90 per cent voltage in all legs of the single phase, or all phases of the multiple phase system. The compact units occupy a depth, including handle for manual operation, of 10½ in. Lake Shore Electric Corp.

19—FLEXIBLE SHAFT for remote valve control

The core of these shafts is made of multiple layers of precision wound high carbon wire. Casing is interlocked metal asbestos packed and is available in galvanized steel or phosphor bronze. According to manufacturer, this flexible shafting with a variety of terminals makes it possible to control any type valve from almost any point in plant. Plain valve couplings for fastening to valve handwheel spokes are available in three types: for rising handwheel valves, for rising stem gate valves, and for non-rising handwheel valves. Quick disconnect valve couplings are also available in these same types. These let coupling be disconnected quickly if it is necessary to operate valve at the handwheel. Special clamps for fastening flexible shaft in place are available, as well as piercing sleeves for going through floors, and a choice of two remote control terminals, with indicators showing when valve is open or closed. Cores are ½ to 1⅝ in. diam. Stow Mfg. Co.

20—SWITCH BOX for installation with old-work jobs

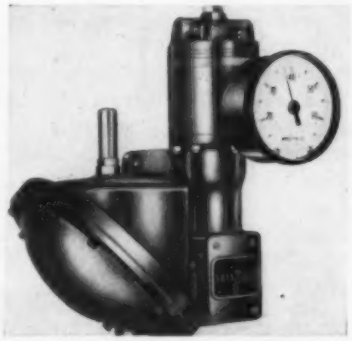
Designed for rapid, easy installation on "old-work" jobs, the Raco Griptite Box can be used on any type of wall, it is noted — wood, wallboard or plaster. It is made of heavy gage metal and anchors by means of a wing-type support with one-screw adjustment. Manufacturer says it is the easiest box to set in place, only three simple steps are required for installation. All Steel-Equipment Inc.

21—FLOW INDICATOR for handling hazardous fluids

Model 3602 Armored Flow Indicator is announced for purge service or flow rate indication of hazardous fluid at pressures up to 1500 psig and temperatures to 400 F. No glass parts are in contact with metered fluid — flow is indicated by tubular follower magnetically coupled to extension on tapered plug in fixed orifice which measures flow rate. A O-ring seal is incorporated. Standard flow rates from 1.5 to 180 gph of water are provided in a single meter body by five plug and orifice sets. Unit is easily disassembled for cleaning or range change without removal from pipe line. Standard construction is of Type 316 stainless steel. Bulletin 360 gives more details. Brooks Rotameter Co.

22—PRESSURE TRANSMITTER for the pneumatic systems

The Metagraphic Absolute Pressure Transmitter is designed to measure pressures in ranges as low as 0 to 5 mm mercury absolute, and transmit the



measurement as a 3–15 psi pneumatic signal to an automatic controller or receiver. Offered to handle pressure ranges from 0–5 mm Hg to 0–760 mm Hg, it transmits a universal 3–15 psi pneumatic signal, and can be used with any standard pneumatic receiver or automatic controller. The Bristol Co.

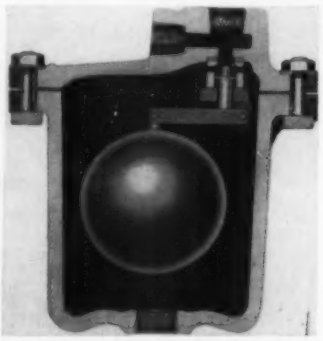
23—ROOF EXHAUSTER, vertical type, aluminum construction

Named the AlumaLung, this vertical unit is constructed of heavy wall extruded aluminum sections with welded seams. It is only 21 in. high and compact in design, yet is claimed to exhaust

more dust, smoke, fumes and excess heat than most roof exhausters of corresponding capacities. No protective coatings are needed to combat weather conditions and air impurities, it is noted, and the louvre-type dampers using the "pin-and-eye" hinge principle and totally enclosed motor do not require lubricants. The AlumaLung is leakproof during severest weather, it is announced, and accumulation of ice or snow does not affect damper operations. The motor support utilized also serves as safety guard to protect personnel. The AlumaLung comes in sizes from 24 to 60 in., capacities from 5400 to 42,000 cfm. It is designed to fit standard roof curbs. The Iron Lung Ventilator Co.

24—VENTING TRAPS offer direct, positive operation

For automatically discharging accumulated air or gas at the high points of a liquid or closed system, these venting traps are designed to offer direct and



positive operation. In sizes and types for practically every requirement, the traps come in semi-steel for high temperatures (to 450 F) to 250 psi and low temperatures to 300 psi; in fabricated steel for high temperatures (to 750 F) to 600 psi and for low temperatures to 1000 psi. Traps are furnished with a stainless steel ball float or with a non-collapsible stainless steel open-end float. Valves and seats are stainless steel. Valve points are guided to assure positive closing. The Clark Mfg. Co.

25—TIME SWITCH provides morning build-up

The improved Weather-Chron is designed to automatically regulate the hours of building heating, and to divide the day into three periods of heating. Two switch circuits are incorporated. The first operates the burner or valve,

Back when...

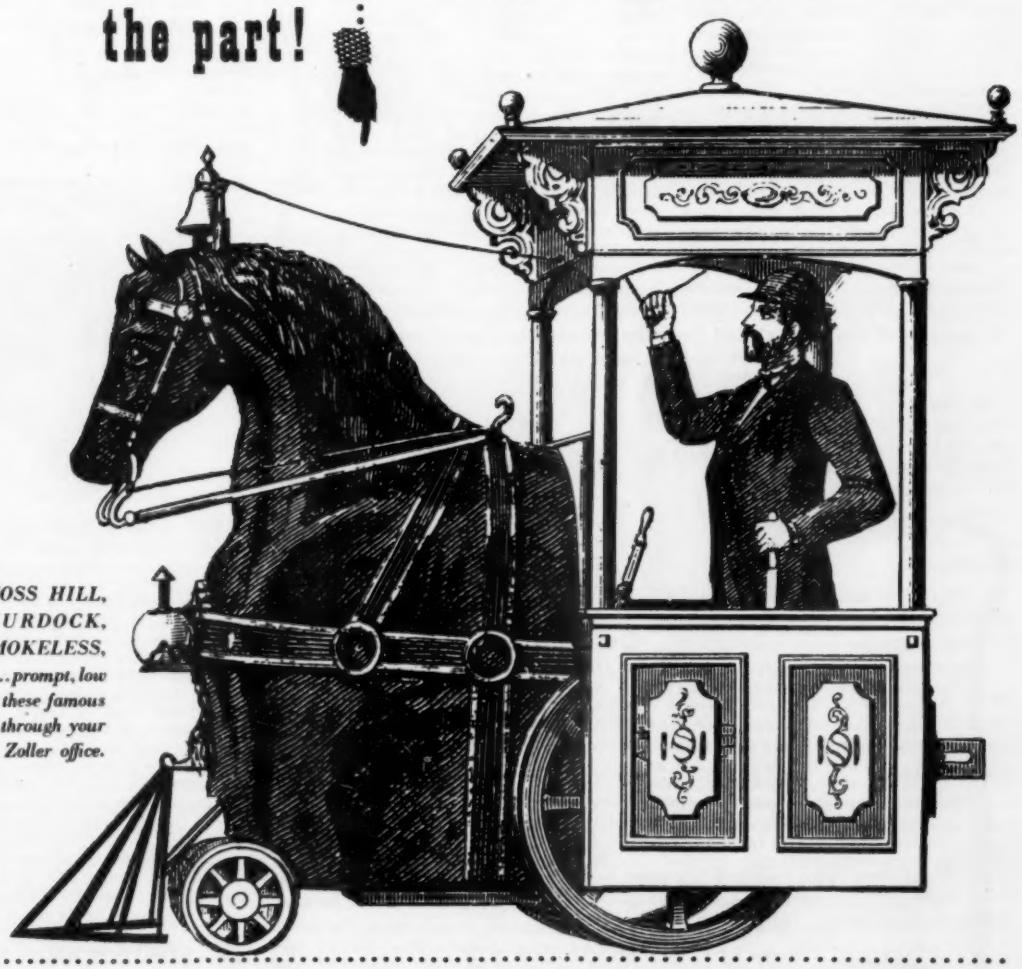
The "Iron Horse" tried to dress the part!

1886! Inventors came up with ideas like this steam-driven "horse car"—guaranteed not to frighten horses.

1886! Bell & Zoller first started marketing their famous free-burning quality coals.

A lot has changed, and a lot been forgotten since 1886. But not this: 70 years ago Bell & Zoller set out to mine, process and deliver the best high-heat, low ash coals by the best, fastest, lowest-cost methods available.

And we're still doing that job in 1956!



ZEIGLER, MOSS HILL, ORIOLE, MURDOCK, LIBERTY SMOKELESS, BUCKHORN... prompt, low cost delivery of these famous brands—now—through your nearest Bell & Zoller office.

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70 YEARS OF SERVICE TO COAL USERS

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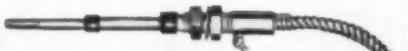
WHICH OF THESE CHARACTERISTICS ARE ESSENTIALS ON YOUR REMOTE CONTROL JOBS?

Accuracy . . . High Load Capacity . . . Adaptability . . . Freedom from Trouble . . . Long Life . . . Flexibility . . . these are some of the qualities of **ACCO TRU-LAY PUSH-PULL FLEXIBLE CONTROLS** that have made it possible to improve the operation of literally hundreds of mechanical products (list on request). Full description of this versatile REMOTE CONTROL is given in our **DATA FILE** available for your further study.

ACCURACY is inherent in the basic design, and in the standards of quality and precise dimension that control the manufacture of TRU-LAY PUSH-PULL CONTROLS. These are precision products, not gadgets.

VERSATILITY of this fine remote control can best be illustrated by citing some of the jobs it handles well . . . **HOT** jobs on jets and industrial furnaces . . . **COLD** jobs down to —70° F. . . . **WET** jobs (the conduit can be completely immersed) . . . **DIRTY** jobs . . . **ABRASIVE** jobs . . . **CORROSIVE** jobs . . . **HEAVY, TOUGH** jobs up to 1,000 lbs input . . . **LIGHT DUTY** jobs . . . **REMOTE** jobs 150 feet or more from the control point . . . these units are frequently and successfully used in conjunction with electric, hydraulic and air controls . . . are thoroughly effective under almost any operating condition.

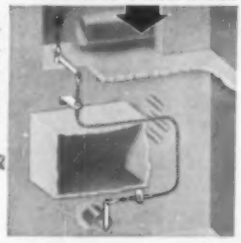


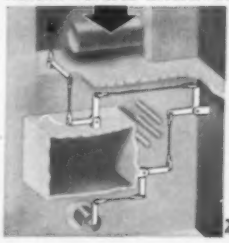
"SOLID as a rod but FLEXIBLE as a wire rope" aptly describes TRU-LAY PUSH-PULL CONTROLS. This *flexibility* provides positive, remote action whether anchorages are fixed or movable . . . it damps out noise and vibration—protects delicate instruments . . . it permits ease of handling and shipping even when assemblies are 100 or 150 feet long . . . it avoids the risk of damage always present with solid tubular controls that must be preformed to position . . . and flexibility greatly simplifies installation of controls by reducing the number of working parts and by making it possible to snake around obstructions. . .

Advantages of Tru-Lay Push-Pull flexibility and simplicity are pictured below

TRU-LAY PUSH-PULL **MECHANICAL LINKAGES**

Simple
One Moving Part
Life-Time Service
Life-Time Accuracy
Low over-all Cost
Noiseless





Complex
Many Parts
Many Points of Wear
Increasing Back-Lash
Loss of Accuracy
Vibration
Rattles

ADAPTABILITY to all sorts of mechanical situations explains, in large measure, the wide-spread application of TRU-LAY PUSH-PULLS. Standard anchorages, fittings and heads have been designed that meet requirements on approximately 80% of the installations. Simple modifications of these standards, or minor changes in your own design, cover almost every special situation. Our engineers have the know-how on such matters.

FREEDOM FROM TROUBLE and **LONG LIFE** are assured even under exceptionally adverse operating conditions because of such things as . . . full protection of the flexible, inner, working member by the tough flexible conduit . . . lubrication of the inner, working member *for life* during assembly . . . seals that keep moisture, dust and other foreign matter out of the unit . . . cold swaging of fittings that makes them integral parts of the control unit. (Full construction details in our **DATA FILE**). We have never heard of a TRU-LAY FLEXIBLE PUSH-PULL CONTROL wearing out in normal service.

Whether your interest is in a single application of this versatile PUSH-PULL CONTROL, or in its inclusion as a component of the product you manufacture, the six booklets and bulletins in this **DATA FILE** will answer your further questions, and will also provide you with the means of defining to us the application you may be interested in.

ACCO *The six bulletins and booklets in the DATA FILE will answer all your further questions. Write for your copy.*

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AMERICAN CHAIN & CABLE

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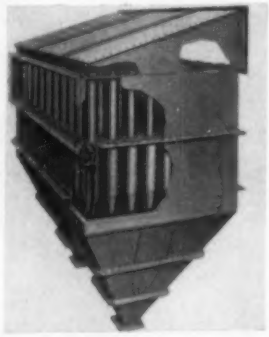
with only the safety high-limit controlled in the circuit regulating heat generation or flow. Starting time of this morning build-up period changes automatically as outdoor weather changes. At a pre-selected time, the second switch of the timer connects the "daytime" heat flow controller with the circuit to provide a regulated heat flow through the day. Heat flow is stopped, or reduced, at pre-selected night hour.

An added safety feature serves to automatically eliminate "night setback" operation when outdoor temperature drops below a pre-selected safe low level (as 10 F). The unit is designed to stop all heat input to the building when outdoor temperature rises above a pre-selected minimum — as 65 F. One-day or seven-day models are available. Automatic Devices Co., Inc.

26—MULTIPLE TUBE COLLECTOR offers increased efficiency

The Cyclo-trell Multiple Tube Collector incorporates design principles which increase gas handling capacity, it is announced, with higher collection efficiency and a greater gas flow for a given pressure drop. Unit consists of a series of



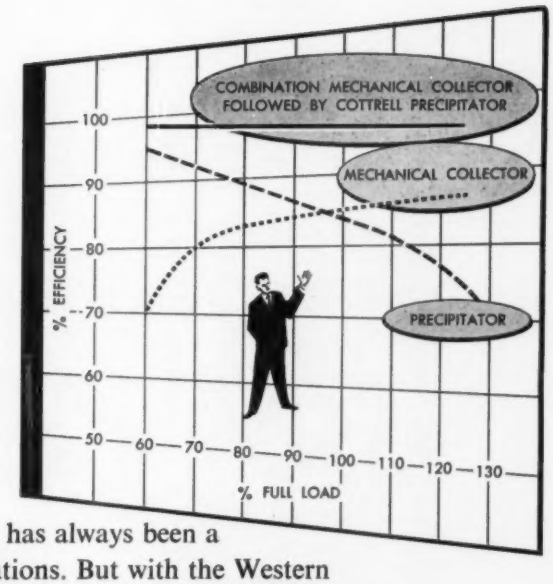
cyclone tubes arranged in parallel, and depends on centrifugal force for its operation. Incoming gas enters chamber under pressure, and flows into lower set of inlet tubes attached to lower header plate and of slightly larger diameter than upper outlet tubes. Inlet vanes at mouth of tubes set up a circular motion in gas so that suspended particles are forced downward and outward against inlet tube wall. Cleaned gas is first forced toward center of collector tube, then upward and into outlet tube by pressure differential. Use of aerodynamically shaped vanes is said to minimize gas turbulence and increase centrifugal force. Outlet vanes serve in recovering energy in outlet tube, increasing tube capacity. Shell and hopper are of 7-gage bolted steel, with cast iron inlet tubes and vanes. Research-Cottrell, Inc.

27—CONTROL VALVE for erosive or gritty process flows

The Sphincter Valve is designed for handling erosive process flows or those containing gritty solids which cannot tolerate pockets but accept Neoprene or natural rubber. It will produce minimum turbulence in the flow through the valve, says manufacturer, and is for use on slurry service where the solids in suspension tend to plug most control valves. Only parts exposed to wear in this valve are a rubber seat and an O-ring.

Advantages of the Western Precipitation CMP Unit

for recovering fly ash in power plant operations



The control and recovery of fly ash has always been a troublesome problem in power plant operations. But with the Western Precipitation CMP unit, new economy and efficiency in the solution of fly ash problems are now being made in both small and large plants.

The CMP is backed by experience unequalled in the industry. Almost a half century ago Western Precipitation pioneered the first commercial application of the now-famous Cottrell Electrical Precipitator to recover suspensions *electrically*, and this equipment is still unsurpassed in its field.

Subsequently, to provide efficient fly ash recovery for low cost installations, Western Precipitation also pioneered the first multiple small tube mechanical recovery unit—the Multiclone Collector—and this unit promptly gained widespread recognition for the new efficiencies it brought to mechanical recovery processes.

From these years of experience gained in *both* electrical (Cottrell) and mechanical (Multiclone) recovery installations, Western Precipitation pioneered another new development—the CMP Unit—*a unit that combines in one compact installation many of the best features of both electrical and mechanical recovery methods.*

In a typical CMP Unit, the stack gases first pass through a Multiclone section where the heavier materials are removed *mechanically*.

The partially-cleaned gases then pass through a Cottrell section where the very small particles are removed *electrically*.

This arrangement offers several important advantages. Removing the heavier particles by Multiclone permits the bulk of the recovery operation to be performed with relatively low-cost equipment. Using a Cottrell for the final clean-up insures unusually high recovery efficiency—approaching theoretically perfect, if desired. Thus, the CMP combines high recovery efficiency with low total cost.

But that's not all. The CMP has the further advantage that the efficiency curve of the Multiclone portion complements that of the Cottrell portion (as shown in the chart above)—*therefore the overall CMP efficiency remains practically uniform at all boiler loads.*

At low boiler loads the recovery efficiency of the Cottrell is highest . . . and at high boiler loads the Multiclone reaches its maximum efficiency. But, by combining the two types of equipment into a *single* CMP Unit, the efficiency curve remains almost flat, regardless of the boiler load.

With CMP equipment, even small power plants can now afford adequate fly ash recovery. However, this fact is all-important . . . full benefit of the CMP principle can be obtained only by a proper balance between the mechanical and electrical sections to fit the individual requirements of *each individual* installation. And no organization is better equipped to provide this critical "know-how" than the *one* organization that has had far more experience than any other in BOTH *electrical* and *mechanical* recovery methods . . . WESTERN PRECIPITATION CORPORATION!

This, the industry's finest recovery experience, is as close to you as your telephone. May we supply further details?

COTTRELL Electrical Precipitators
MULTICLONE Mechanical Collectors
CMP Combination Units
DUALAIRE Reverse-Jet Filters
HOLO-FLITE Processors

Western Precipitation Corporation

Designers and Manufacturers of Equipment for Collection of Suspended Materials from Gases

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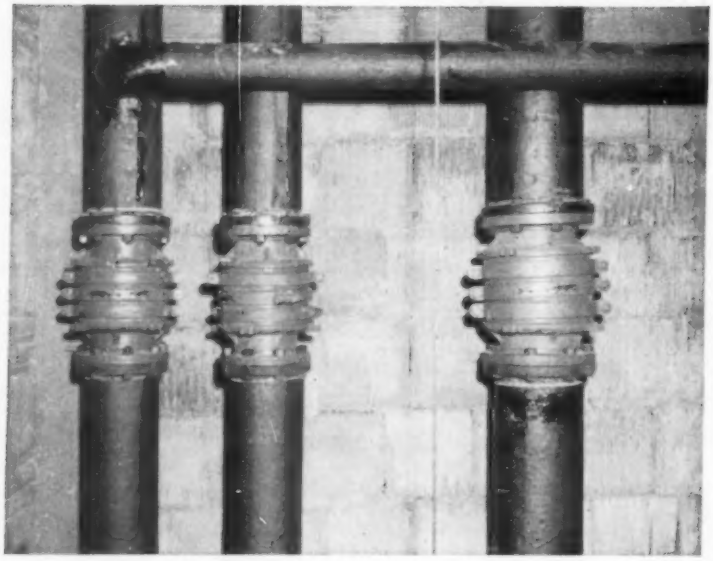
Expansion, Misalignment Problems Solved with Flexon Expansion Joints in Heating—Air Conditioning Piping



FLEXONICS
A Single Source for Every Expansion Joint Requirement

Flexonics Corporation manufactures a complete line of expansion joints in free-flexing, controlled-flexing and special types. Sizes range from 3" up.

Ask for your copy of the Flexon Expansion Joint Design Guide. It provides application and installation data for a wide range of services.

The Flexon Expansion Joints illustrated above are protecting the new heating and air conditioning piping just installed for the Engineering Building, Chicago, Illinois.

During the winter months, the risers shown carry hot water for heating this modern 23 story office building. When summer comes, this same system is utilized for the circulation of chilled water for air conditioning.

These Flexon Expansion Joints are designed for the double duty they perform here and will handle axial movement up to 3". They are rated for pressures to 150 psi and temperatures to 500° F. They also compensate for misalignment in piping.

Flexon Expansion Joints can protect your piping from the dangerous stresses of thermal motion and misalignment which could eventually result in piping failure.

They are manufactured by pioneers in the fabrication of corrugated metal assemblies with over 54 years of experience. For routine or unusual applications, play it safe, specify Flexon Expansion Joints.

FLEXON® QUALITY
proved in service and backed by over 54 years manufacturing experience

EJ26

Flexonics *Corporation*
EXPANSION JOINT DIVISION
1374 S. THIRD AVENUE, MAYWOOD, ILLINOIS
FORMERLY CHICAGO METAL HOSE CORPORATION
Manufacturers of flexible metal hose and conduit, expansion joints, metallic bellows and assemblies of these components.
In Canada: Flexonics Corporation of Canada, Ltd., Brampton, Ontario

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The former is compressed along its axis to produce throttling action and tight closure. At present, ⅜-and ¼-in. OD tubing sizes are available. Parts exposed to process may be bronze, steel or stainless steel. Manual or air operators are available for quick interchange. George W. Dahl Co., Inc.

28—CARD HOLDER KIT identifies electrical circuits

This inexpensive identification card holder kit provides neat, legible identification of electrical circuits and installations. Card holder kits are available

for switches, enclosed circuit breakers, switchboard circuits, panelboards and load centers. Installation takes only a few minutes. Two small holes are drilled and holder is anchored firmly to device with two self-tapping screws. Ten card holder assemblies, individually packaged, are in each kit. Square D Co.

29—POCKET TOOL strips and cuts copper wire

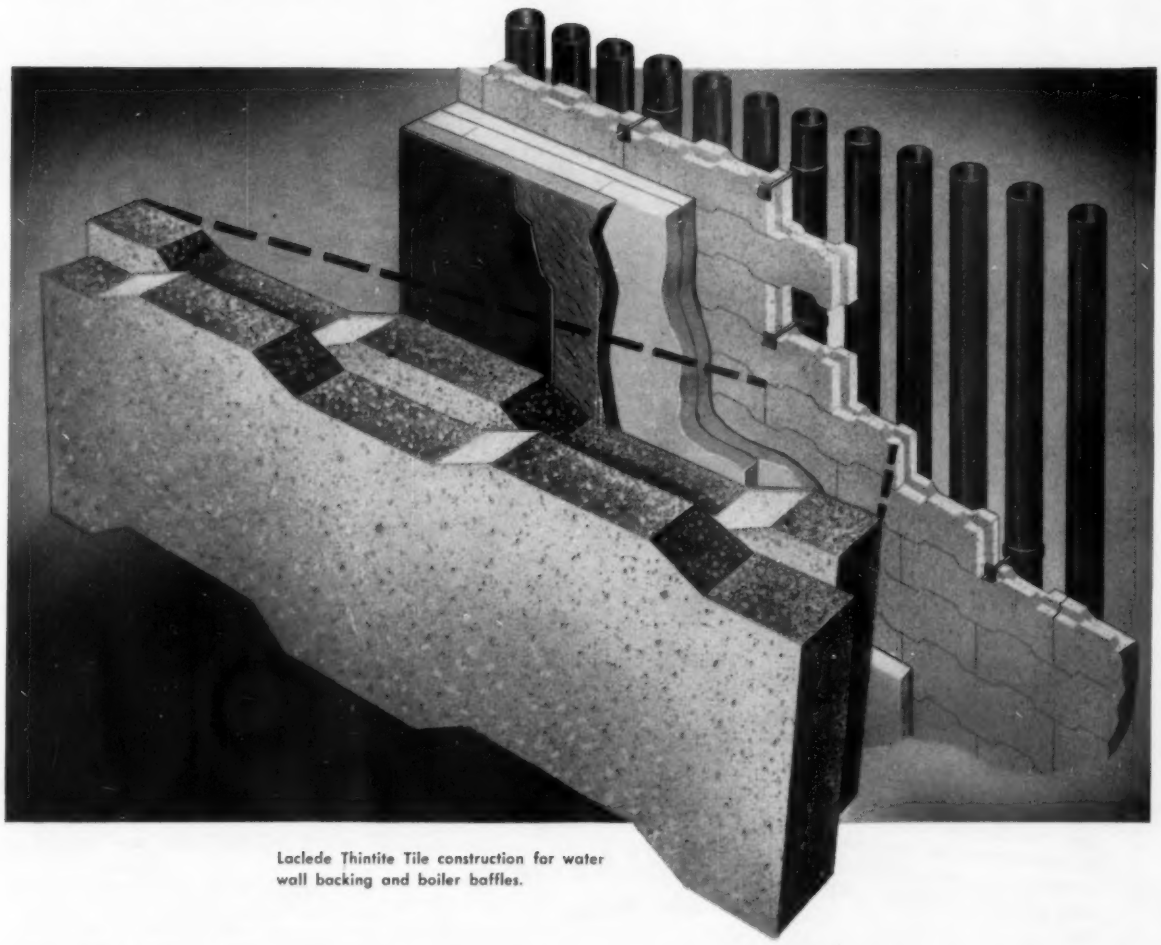
For electrical, machine shop and other applications, this pocket-size wire cutter and stripper has a wire size adjustment

for easy wire stripping. For this, you simply set the adjusting stop to the wire size, close the jaws of the tool around the wire, hold firm and strip clean to the bare wire with an easy "straight pull" motion. Tool is 5 in. long, costs around $2.00. Jo-El Co.

30—LUBRICATING SYSTEMS for high temperature uses

Centralized lubricating systems designed to withstand temperatures to 500 F while providing fully automatic lubrication are announced. The systems

New trends in the use of refractories



Laclede Thintite Tile construction for water wall backing and boiler baffles.

Reduce your costs, speed up installation with interlocking Laclede Thintite Tile

Thinner, lighter weight refractory furnace enclosures reduce maintenance and labor costs, weight and wall thickness and lower cost of new boiler settings.

Interlocking Laclede Thintite Tile offers *exclusive* advantages for water wall backing, as well as for boiler baffles and roof coverings. Tile sections interlock quickly and easily, reducing installation time and lowering cost per square foot. This interlocking design keeps the wall tightly sealed—reduces leakage to a minimum. Also, the Thintite wall is completely uniform—free from deformation or warpage.

Light weight Thintite Tile is machine-made of first quality fire clay to a single shape. The single shape permits use of Thintite for walls, baffles and roofs, thus reducing inventory requirements.

When you need boiler refractories, be sure to consider Laclede's Thintite Tile. Call your Laclede-Christy representative for all the facts.

LACLEDE-CHRISTY COMPANY DIVISION

LACLEDE-CHRISTY COMPANY FOUNDED 1844 Quality First — HKP — H. K. PORTER COMPANY, INC.

H. K. PORTER COMPANY, INC.
2000 Hampton Ave. · St. Louis 10, Missouri
Mission 7-2400

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DOUBLE BOILER BLOW-OFF SAFETY

1

Quick-Operating
EVERLASTING
Straight-Through Valve

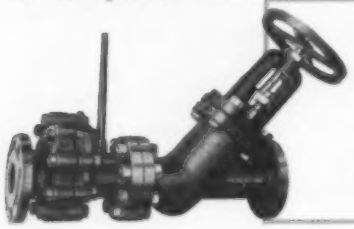
The standard Everlasting design which opens with a quarter-turn of the lever and closes with a drop-tight seal that actually improves with use.

2

Shock-Resisting
EVERLASTING
Angle Valve

Specially designed and stoutly constructed to withstand severe service and the shocks and abrasion of blow-down solids.

Conform with ASME codes. Available in a range of sizes for pressures up to 600 psig. *Write for descriptive bulletin.*



EVERLASTING DUPLEX UNITS

also available with Y Valves and in any combination of Quick-Operating, Angle and Y Valves.

For "everlasting" service, use

EVERLASTING Valves

EVERLASTING VALVE CO.
47 FISK STREET, JERSEY CITY 5, N. J.

EV 203

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use valves and filters that combine heat-resistant qualities with desired filter and flow control characteristics, company states. Successful use on different types of machinery operating under temperatures from 200 to 500 F is reported — including flatwork ironers in commercial laundries, and valve stems of large industrial gas engines. High temperature units are available in most of this company's cyclic, continuous and "one shot" centralized lubricators.

The new systems are made up of three basic components: 1) a combination pump-reservoir that feeds oil at a predetermined frequency and volume into 2) a single-line distribution system, with junctions and branch lines leading to each lubricating point where 3) a meter-unit filters and measures the oil and maintains the one-direction oil flow. Bijur Lubricating Corp.

31—WIRE BRAID HOSE has grease-resistant cover

Revelation Wash Up Hose is announced as a wire braid hose with a specially-compounded, white Neoprene, grease and fatty oil-resistant cover. The product was developed for maximum flexibility under high pressure hot water and steam conditions and extra-severe service requirements, as found in fish canneries, meat packing houses, dairies and food processing plants. The inner tube is made of a heat-resisting compound for extra long life under hot water and steam service. A high tensile steel wire braid reinforced carcass prevents hose from bursting or rupture. The white Neoprene cover is inseparably bonded to wire carcass by a ply of high tensile, heat-resisting cord yarn. Hose is available in ¼-, ¾- and 1-in. ID sizes. Hamilton Rubber Mfg. Co.

32—V-S MOTOR for low speed applications

Type VEV-1-GD (double reduction) and Type VEV-1-GM (triple reduction) Varidrives are variable speed, internally-geared units, with take-off shaft and motor on the same side. They are sug-

gested for low speed applications requiring variable speed, where weight distribution and limited space are factors. Units are available through 5 hp. Both upright and horizontal assemblies are on production with dripproof, totally enclosed or explosion-proof motors. Designed for rugged duty, these Varidrives are also described as extremely compact, and as providing slow speeds and high torque without use of separate gear boxes, speed changers and other equipment. U. S. Electrical Motors Inc.

"As an engineer, I insist on the GUARANTEED EFFICIENCY of Packaged Boilers"

"Boiler efficiency used to be an X factor – an unknown gamble where the odds were stacked against the buyer. No engineer likes to gamble, so we used to recommend oversize boilers, just to play it safe.

"Then, to answer a major industrial need, the Packaged Boiler was developed. With its *guaranteed efficiency* of 80%, it eliminates all our guesswork. Now we can specify exactly the right size boiler for every job. When plant expansion calls for greater steam production, additional Packaged Boilers can be added – easily, economically, conveniently.

"Packaged Boiler efficiency doesn't fluctuate, either. It stays almost constant throughout a wide load range . . . and throughout the long life of the boiler."

Six Reasons Why it Pays to Buy a

CONTINENTAL

Automatic Boiler

* Guaranteed 80% efficiency . . . Fire-tested before shipment . . . Range, 20 to 500 hp.
* Simple, practical two-pass design, for uniform flow of combustion gases through all return tubes.
* Maximum radiant heat transfer achieved by "Spinning Gas" technique for thorough mixing of air and atomized fuel.
* High-CO_2 and low-temperature stack gases — proof of high combustion efficiency.
* Free, rapid water circulation improves heat transfer, keeps heating surfaces clean.
* Easy access to furnace and all return tubes. Refractory baffles and brickwork are not required.

For details on the Continental Automatic Boiler, send for Bulletin BE-3

BOILER ENGINEERING & SUPPLY COMPANY, INC.

3 Manavon Street, Phoenixville, Pa.

A HALF CENTURY OF BOILER MANUFACTURING EXPERIENCE

The Continental AUTOMATIC BOILER

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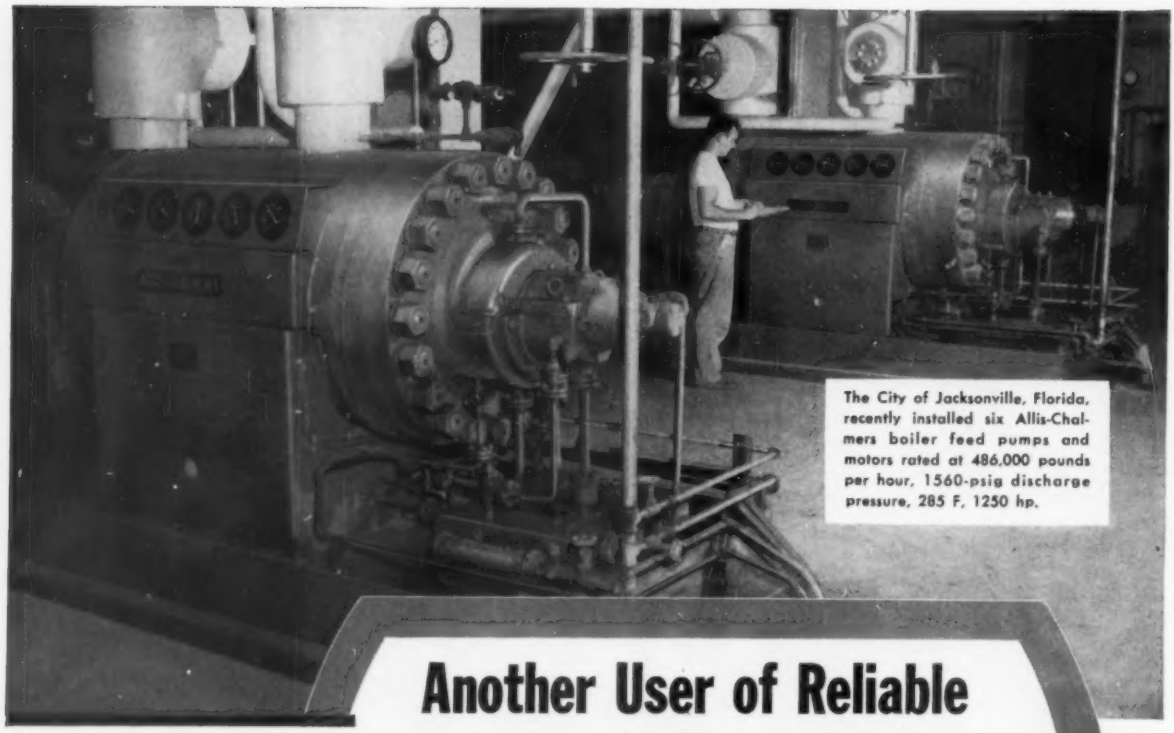

The City of Jacksonville, Florida, recently installed six Allis-Chalmers boiler feed pumps and motors rated at 486,000 pounds per hour, 1560-psig discharge pressure, 285 F, 1250 hp.

Another User of Reliable ALLIS-CHALMERS barrel-type PUMPS

City of Jacksonville

Here are the reasons **for wide acceptance of these pumps:**

- Outstanding performance — fully proved by service records.
- High efficiency and smooth operation under fluctuating loads — first stage has twin, single-suction impellers for low NPSH requirements.
- Simple maintenance—expansion joint and shaft seals are brought to outside of pump where they can be easily inspected.
- No balancing device needed—axial balance is maintained by back-to-back mounting of the impellers.

THERE are outstanding features like these throughout the Allis-Chalmers line. Whether you require boiler feed, condensate, circulating or other power plant pumps — it pays to standardize on Allis-Chalmers.

In addition, A-C can supply pumps, motors and control of coordinated design and manufacture. This means one responsibility — one guarantee of satisfaction.

Get complete information on barrel-type boiler feed pumps. Call your nearby A-C office or write Allis-Chalmers, General Products Division, Milwaukee 1, Wisconsin for Bulletin 08B7899.

A-4854

ALLIS-CHALMERS

A-C ALLIS-CHALMERS

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For lowest cost steam, KVP Company burns coal the modern way

Consult an engineering firm

Designing and building hundreds of heating and power installations a year, qualified engineering firms can bring you the latest knowledge of fuel costs and equipment. If you are planning the construction of new heating or power facilities—or the remodeling of an existing installation—one of these concerns will work closely with your own engineering department to effect substantial savings not only in efficiency but in fuel economy over the years.

facts you should know about coal

In most industrial areas, bituminous coal is the lowest-cost fuel available • Up-to-date coal burning equipment can give you 10% to 40% more steam per dollar • Automatic coal and ash handling systems can cut your labor cost to a minimum. Coal is the safest fuel to store and use • No smoke or dust problems when coal is burned with modern equipment • Between America's vast coal reserves and mechanized coal production methods, you can count on coal being plentiful and its price remaining stable.

The engineering department of the Kalamazoo Vegetable Parchment Company, following an extensive fuel survey, decided to meet increased power demands by burning coal the modern way.

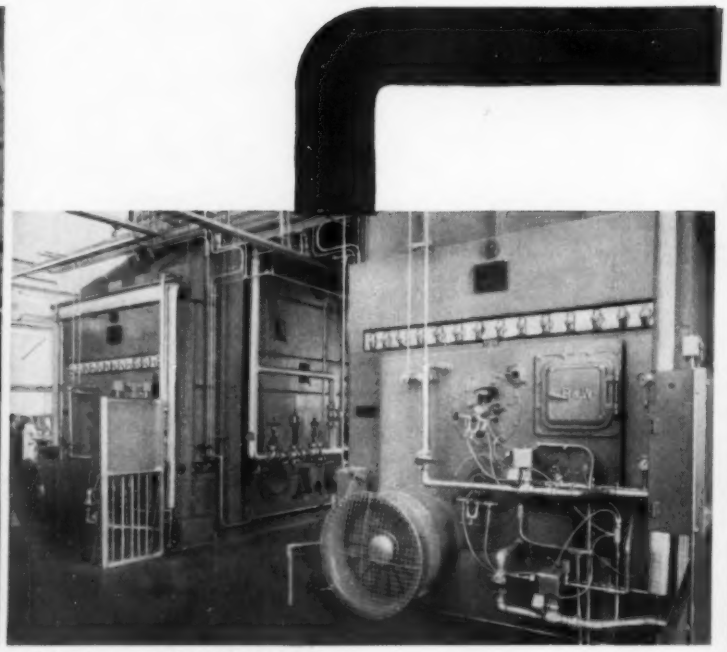
Five of eight existing coal fired boilers of varying age were replaced by one new boiler capable of burning a diversified range of coals. In addition, automatic coal handling equipment was installed. With it, coal is automatically dumped, magnetically cleaned, carried to the power house by a moving belt, crushed, pulverized and fed into the furnace.

These new facilities have resulted in increased steam capacity, lower operating costs and lower fuel costs.

For further information or additional case histories showing how other plants have saved money burning coal, write to the address below.

NATIONAL COAL ASSOCIATION
Southern Building • Washington 5, D. C.

For more data circle 537 on Post Card

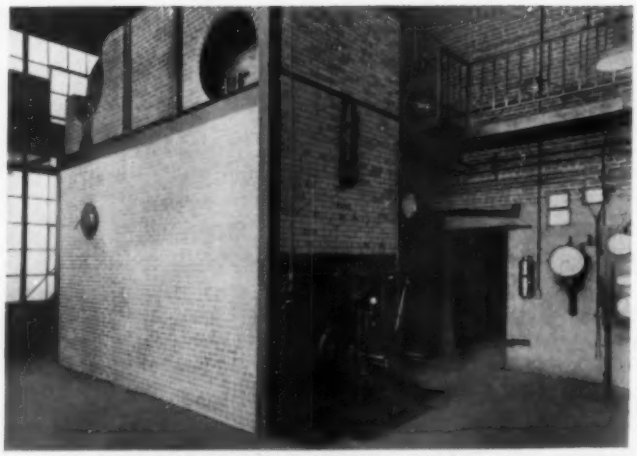


Both Kansas City Plant and Gastonia, N. C. Plant, newest of the H&D plants, have two 18,000 lb per hr boilers. The Kansas City boilers use either gas or oil depending on availability. The Gastonia boilers use oil only. All these boilers have forced-draft fans mounted directly on the burner windbox.

B&W BOILERS:

A 35-YEAR ACCEPTANCE STORY AT HINDE & DAUCH H&D

Hinde & Dauch operates corrugated box factories in major markets of the East, Midwest, and South



This oil-fired 150 HP B&W Boiler went into service in 1930, at H&D's Baltimore box factory.

The Hinde & Dauch Paper Company is one of the country's largest manufacturers of corrugated paper materials. Its remarkable growth since 1882, from a single threshing machine and straw baler, has been paced by ingenuity in adapting the product to varying conditions—virtually making markets where none previously existed.

As a leading corrugated box manufacturer, H&D requires an efficient, dependable steam source in each of its many plants scattered around the country. And since 1921, when three 516 HP B&W Boilers went into service in the company's Fort Madison, Iowa plant, The Hinde & Dauch Co., has been using B&W Boilers of various types and capacities in its plants from Watertown, Massachusetts to Kansas City, Kansas—the strongest possible indication of acceptance based on performance.

Since 1946, B&W Boilers for H&D have been of the Integral-Furnace Type. In its newest plant at Kansas City, Kansas, two B&W Integral-Furnace Boilers went into service in November of 1955. Each unit provides 18,000 lbs of steam per hr and is equipped for oil and gas firing. Some of the other H&D installations have provision for future stoker firing, to afford full benefit from fuel price fluctuations. Today there are 19 B&W Boilers in service at H&D plants, for a total of 275,000 lb of steam per hr.

For the past 35 years, Hinde & Dauch has been relying on B&W Boilers for dependable, economical steam. Like many more industrial concerns in various categories, this company has found B&W Integral-Furnace Boilers ideally suited to its steam requirements, both processing and heating. Take a tip from this long association if you are considering steam plant modernization or expansion. B&W Integral-Furnace Boilers are available in individual capacities to meet any requirements from 2900 to 350,000 lb of steam per hr.

Write for complete details to The Babcock & Wilcox Company, Boiler Division, 161 East 42nd St., New York 17, N.Y.

B&W INTEGRAL-FURNACE BOILERS
OFFER THESE 10 COST-SAVING ADVANTAGES

- Minimum floor space and headroom requirements
- High fuel economy
- Smokeless combustion
- Adaptable to all fuels and firing methods
- Economical fast steaming
- Water-cooled furnace
- Clean, dry steam at all ratings, even with high boiler water concentration
- Quick response to wide and heavy load swing demands
- Easy to inspect and clean
- High availability with least attention

BABCOCK & WILCOX

BOILER DIVISION

G-777

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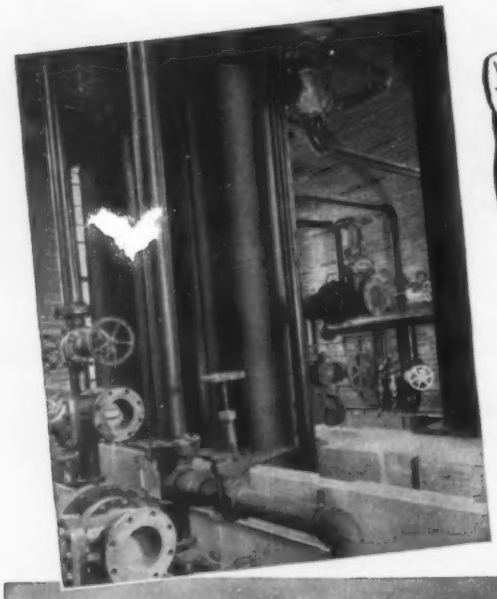
Dirty Water can't "Shut-down"...

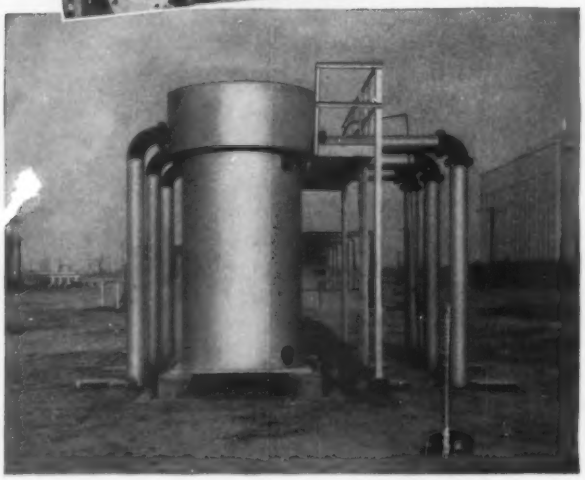
Vogt



film type exchangers

(Condensers—Coolers—Evaporators)

Patent Nos. 1,935,270 - 2,057,597 - 2,424,441



River water, well water or brackish water are all alike to this exchanger *because it can be cleaned* while in operation! The water distributing ferrules need only be removed successively for the cleaning brush or tool whereby the tubes receive additional water which sluices away the dislodged dirt.

Vogt Film Type Exchangers are operating with real economy of first cost, operation and maintenance in power, petroleum, and chemical industries. They serve as Jacket Water Coolers, Feed Water Heaters, Hydrocarbon Evaporators, Sulphuric Acid Coolers, and Sulphur Dioxide Condensers, and can be designed to cool or heat any liquid and to condense or evaporate any fluid.

TOP: *Four units at Newton Falls, Ohio Municipal plant cool water for diesel engines and a lubricating oil cooler.*

BOTTOM: *Jacket Water Coolers serving engines of 7,300 HP in the compression plant of a Western Oil Refinery.*

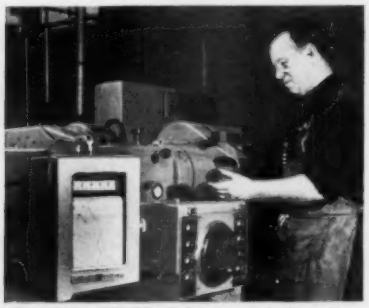
[Bulletin HE-7 describes typical installations of Vogt Film Type exchangers and is available upon request. Dept. 24-XPE]

HENRY VOGT MACHINE CO., LOUISVILLE, KY.

Sales Offices: NEW YORK, CHICAGO, CLEVELAND, DALLAS, PHILADELPHIA, CINCINNATI, ST. LOUIS, CHARLESTON, W. VA., SAN FRANCISCO

For more data circle 539 on Post Card

CF-7 Hook-on Recorder can record loads on lighting circuits with minimum servicing or attendance by plant personnel.



Portable CH Model on a typical application, measures the efficiency of repeat operation machinery to improve production.

Switchboard CH Model provides a continuous indication and record of load; uses extra-long record rolls, throw-away inkwell.

When plant management has problems . . .

General Electric Recorders Help Get Answers with Accurate Records

In power generation—You can use the General Electric CH switchboard model recorder to help solve operating problems where you need to chart a continuous record of frequency; determine station output; and graph peak loads at all hours.

It offers you a versatile means of charting a continuous record of an electrical quantity against time. Surface and semi-flush panel-mounted models can measure and record current, voltage, power, frequency, or speed with up to 28 chart speeds from ¼ inch per hour to 2 inches per second. Speeds are changed easily.

In power utilization—You can use the General Electric CF-7 hook-on recorder to help solve operating problems of motor-driven machinery and distribution loads, and for making voltage and current surveys.

Easy to use, the CF-7 hook-on recorder offers you a multi-range means of recording varying loads up to 750 amperes. The CF-7 can measure and record either current or voltage; has seven ranges: 15/75/1 50/750 amperes, a-c; and 150/300/750 volts, a-c. Butyl-molded hook-on transformer is ASA rated to 8700 volts. The inkless CF-7 can operate for 30 days without attendance.

For full information on how both the CH and CF-7 recorders can help you solve plant operating problems, write Section 582-15, General Electric Co., Schenectady 5, N. Y., or contact your nearest G-E Apparatus Sales Office.

Progress Is Our Most Important Product

GENERAL ELECTRIC

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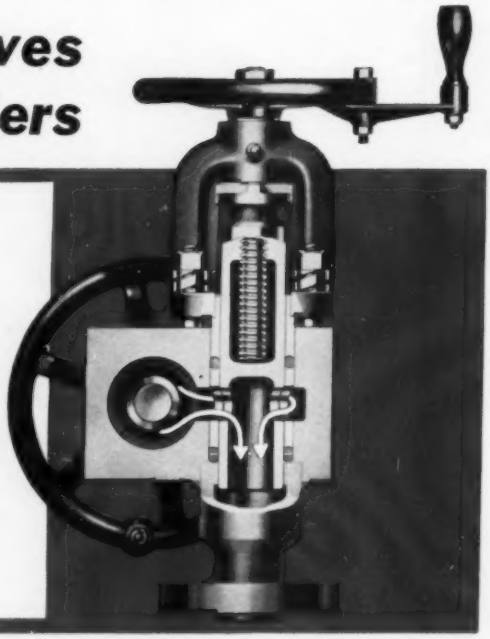
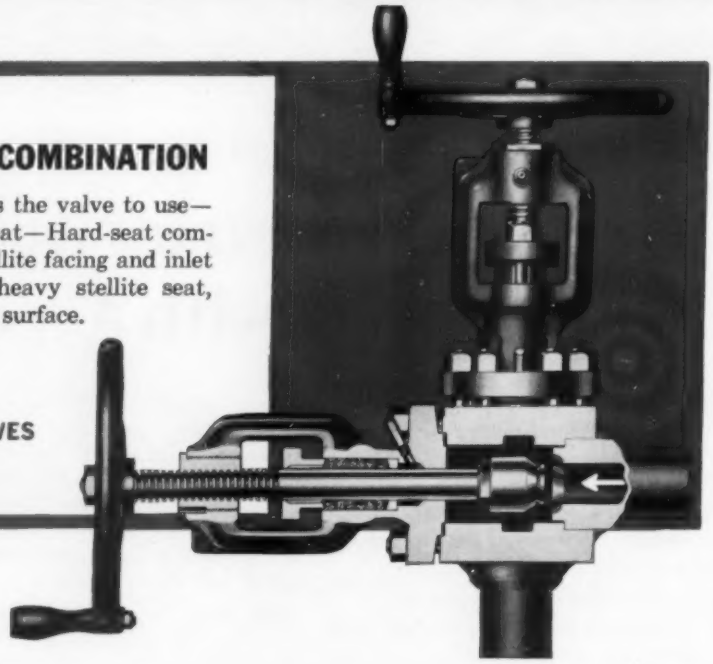
UNIT TANDEM

rugged blow-off valves for high pressure boilers



HARD-SEAT—SEATLESS COMBINATION

■ For boilers up to 1500 psi, this Yarway Unit Tandem Blow-Off Valve offers the maximum in dependable service. A one-piece forged steel block serves as the common body for the Yarway Stellite Hard-seat blowing valve and the Yarway Seatless sealing valve. All interconnecting flanges, bolts and gaskets are eliminated. The Unit Tandem at right is sectioned through Seatless Valve to show balanced sliding plunger in open position and free flow.



HARD-SEAT—HARD-SEAT COMBINATION

■ For boilers to 2500 psi, this is the valve to use—Yarway's Unit Tandem Hard-seat—Hard-seat combination. Disc has welded-in stellite facing and inlet nozzle has integral welded-in heavy stellite seat, providing smooth, hard-wearing surface.

OVER 4 OUT OF 5
HIGH PRESSURE PLANTS
USE YARWAY BLOW-OFF VALVES

Write for Yarway Catalog B-434

YARNALL-WARING COMPANY
100 Mermaid Ave., Philadelphia 18, Pa.
BRANCH OFFICES IN PRINCIPAL CITIES

YARWAY BLOW-OFF VALVES

For more data circle 541 on Post Card

How Nuclear Reactor Fuel Elements Work

And how they are fabricated by the Babcock & Wilcox Co. at their new Lynchburg, Va. plant

NEAR LYNCHBURG, in Virginia, The Babcock & Wilcox Company have just put into operation the first privately built nuclear fuel element fabricating plant in the country. They are at present making fuel elements for the AEC Material Testing Reactor in Idaho and for The Consolidated Edison Company of New York's nuclear power plant to be built at Indian Point in New York State.

Here is a brief description of the way fuel elements operate and how they are fabricated in this new plant.

The working material for the fuel elements will depend on the kind of reactor. For the Materials Testing Reactor, for example, the fuel elements are made of an alloy of approximately 13 per cent enriched uranium (i.e. uranium 238 containing more than its normal share of uranium 235) and 87 per cent aluminum. The uranium makes the alloy radioactive, but no chain reaction can occur until enough of the alloy is concentrated in one spot. In the reactor core enough of this alloy is concentrated to form what is known as the critical mass, and as soon as this critical mass has been assembled the fissioning of the uranium forms a chain reaction which is self-sustaining. In a reactor this reaction is controlled so it does not become too violent (as it does in a bomb) and the heat liberated during the reaction is used to generate steam and produce electric power.

Effect of Fission Products

After several months operation the reaction is slowed down by the accumulation of fission products, and the fuel has to be removed and reprocessed. Reprocessing means separating the uranium from the fission products so the uranium can be used again.

Many people are puzzled over nuclear burning because there is no apparent change in the fuel after it has been burning for several months. When a piece of coal burns, the resulting ash is very different from the original coal, but when uranium alloy burns in nuclear fission the alloy looks much the same as it did before.

The reason the uranium seems unchanged is that the amount of uranium that has been converted into fission products is so small (a very small percentage) that it cannot be seen by the naked eye. These fission products are distributed evenly throughout the material of the fuel element in sub-microscopic amounts.

This is yet another example of the enormous forces contained in the nucleus . . . the fact that such a small amount of material can supply so much energy . . . that after generating power for several months the amount of fuel used is so small it cannot even be seen.

The fission products slow down the reaction because they absorb neutrons that would otherwise be available for more fission.

Since uranium oxidizes very readily, the fuel elements are clad in aluminum, zircalloy or stainless steel. The elements are made up into strips and then assembled in "club sandwiches" as shown in the photograph.

In the reactor the assemblies are held in a vertical position and water circulates between the strips and carries away the heat produced by the fissioning. This water is then passed through a heat exchanger where steam is produced and this steam drives a turbine generator.

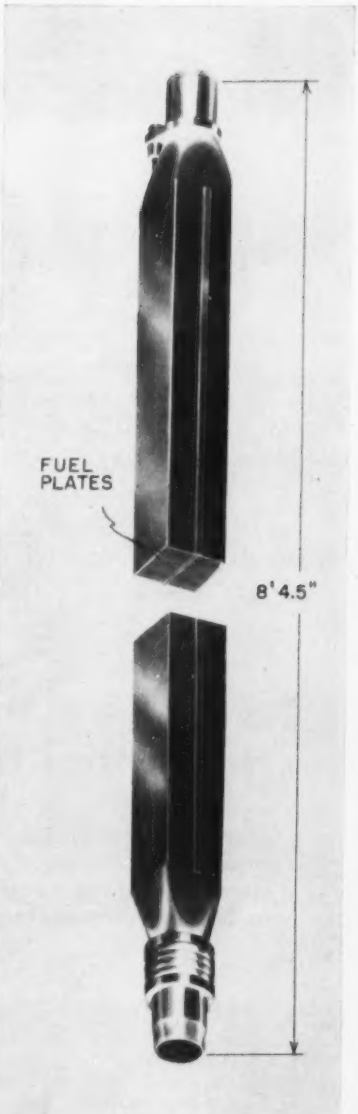
How B & W Makes the Elements

The B & W plant receives enriched uranium from the AEC. This uranium is then alloyed with the required amount of aluminum or other material that is to be used for the fuel elements, and then it is rolled and machined into the right sized strips as part of the fuel element assemblies.

Strict precautions have to be taken in the plant to make sure the uranium is never concentrated in amounts large enough to form a critical mass. In the vault where the uranium is stored it is carefully separated into small quantities, and in the plant a trolley system is used so that only a limited amount of uranium is permitted on one trolley and each trolley load of material passes through one complete process before the next one is started so there will be no danger of an accidental accumulation of too much uranium in any one spot.

At the same time there is a continual and strict accounting, down to the last 1/100 gram, of all the uranium in the plant. In effect, B & W borrows uranium from the AEC, and at any moment they have to be able to account for every scrap of this borrowed material.

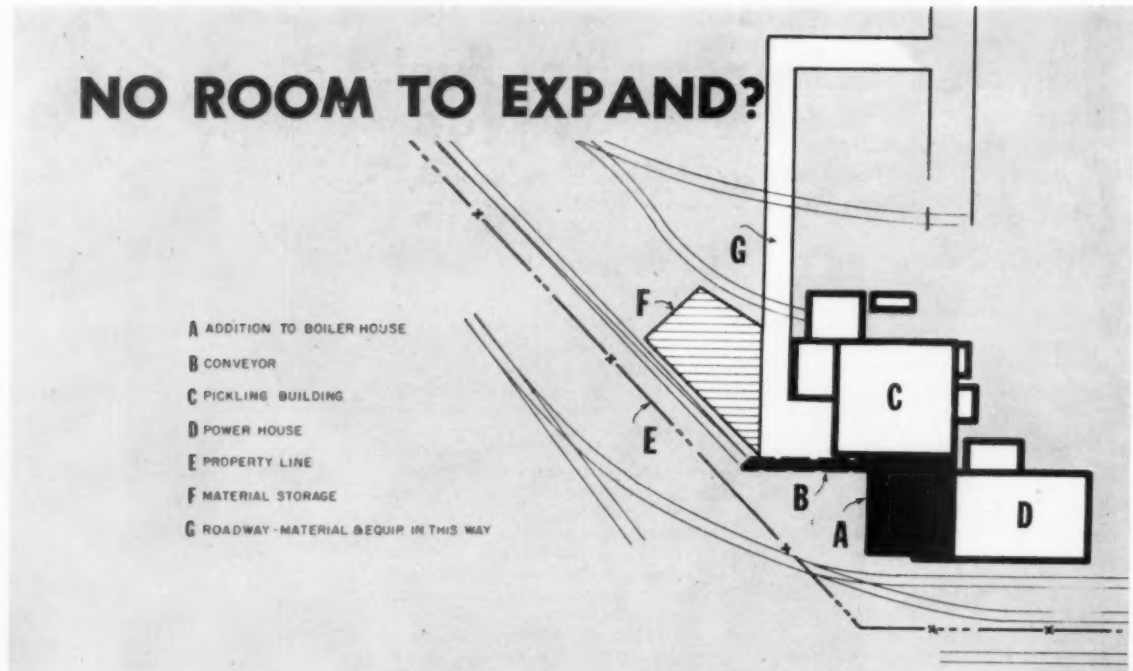
In addition to the fabricating plant, B & W have built a Critical Test Facility at Lynchburg. This is a small reactor, complete with control and measuring equipment, in which working models of reactor fuel elements can be assembled and tested.



One of fuel element assemblies for Con Edison's nuclear power plant

In the design of fuel elements and reactor cores there are so many variables that information can be obtained more easily by experiment than by calculations. Much the same thing happens in aircraft design where wind tunnel models are used to collect data that would be too cumbersome to obtain theoretically.

In the Critical Test Facility the fuel element models are made critical, i.e. enough material is concentrated to make a continuous fission reaction occur, but it is kept on a very small scale, so very little heat or power has to be dissipated, yet the information obtained is quite accurate and much cheaper than making experiments on a full scale power reactor.



Here's How Dana Squeezed In Another Boiler

Plant growth or process demands frequently require expansion of existing steam capacity without enough space to install new equipment; when this happened to Dana, they "made" space by using some ingenuity

By HARRY SCHULTZ *

STEAM IS IMPORTANT to any manufacturing operation, and when a company faces the prospect of running out of it either figuratively or literally — as the saying goes — something's gotta give.

Dana Corporation's Detroit Division, which produces automobile frames, was faced with such a problem when recently it was told that its source of supply for steam would soon become unavailable.

This meant a complete power house would have to be built especially for the plant. However, such a project in itself posed a serious dilemma because of limitations of time and space.

Started Small

Like so many American plants, when the Detroit Division was started it was relatively small in physical size. Located in the Detroit suburb of Ecorse, plenty of vacant land surrounded its first unit when it was built in 1927.

Initial section of the plant produced stampings on what would now be considered a small scale. When this unit was erected, a power house with boiler capacity sufficient for little more than the stamping operation was provided.

Adjacent to the property occupied was the plant of Great Lakes Steel Company, now a subsidiary of National Steel Corporation. Starting in 1931, and several times thereafter, our plant was expanded in order to accommodate additional manufacturing operations, occupying new factory space built contiguous to the original unit.

Great Lakes Steel was enjoying similar growth at the same time. Result was that our plant not only found itself occupying substantially all of the land originally purchased, but the steel company's concurrent growth had so hemmed it in, no adjacent land was available for additional construction.

The boiler house erected in 1927 showed unmistakable signs of being seriously over-taxed during the late 1930's.

Rather than construct additional boiler capacity at that time, however, the Division made a deal with Great Lakes Steel to obtain the steam needed. Great Lakes was then looking for ways of disposing of excess steam generated in its open hearth stacks, and was glad to pipe some of it into our plant.

This worked to everyone's satisfaction for some time, but Great Lakes continued to grow and eventually found itself in the position of needing more and more steam for its own operations.

Steam Supply Cut Off

A point was eventually reached where what was once waste steam would in itself be insufficient to meet all the needs of Great Lakes. Hence that company not only had to recapture it for its own use, but actually had to provide additional facilities for generating still more steam to meet existing steel-making needs.

In the fall of 1953, Great Lakes announced that they would be unable to supply steam to us after October 1, 1954. A year is not much time to erect any sort of building nowadays. In our case it seemed to pose an impossible situation.

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*Plant Manager, Detroit Division, Dana Corporation, Detroit, Mich.

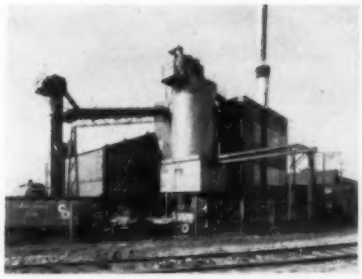


Fig. 1. View of power house, ash silo, and coal-handling conveyor. Property line fence, foreground, shows boundary

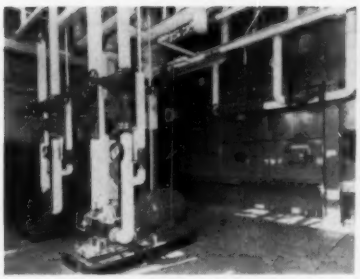


Fig. 2. A side view of boiler showing two boiler feed pumps in foreground; one is steam-driven, other, electrical

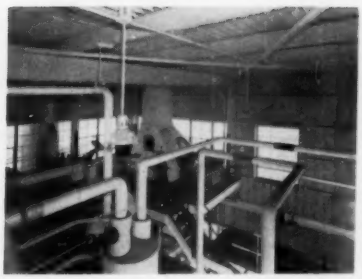


Fig. 3. General view at level of the upper boiler drum; draft fan and stack can be seen behind piping, background

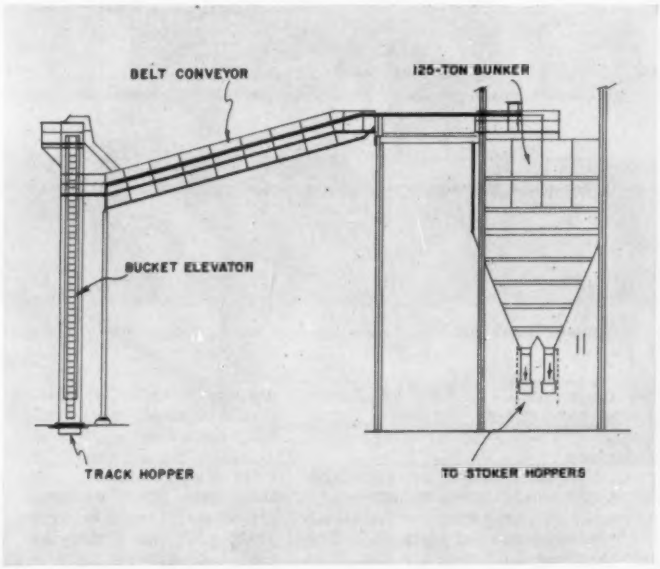


Fig. 4. *(Left)* A simplified drawing of coal conveyor (see "B" in title plate)

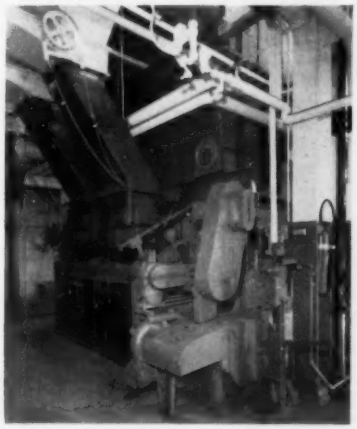


Fig. 5. Front view of boiler; shown are stoker drive, controls, bunker chutes

The problem was not so much the design and erection of a boiler house as it was where to build it. Another irksome problem was the unfavorable location of railroad facilities suitable for coal handling.

Surveys indicated that, by using a high degree of ingenuity, it would be possible to erect a power house adjacent to our old boiler house but, in any case, it was going to be an extremely tight fit.

Two railroad sidings were available, but one depended upon access through the steel plant's property and was frequently blocked by its operations. Also, on that siding, there was no room to hold cars, so it had to be ruled out.

Better luck was had with the second siding, which runs entirely through our own property and is long enough to store as many as three coal cars at a time.

This siding had the disadvantage of necessitating a long overhead conveyor to the coal bunker. When installing the new boiler, we were required to reverse the firing side, a somewhat unfavorable deviation from the boiler layout existing in the old power house section that was to be utilized with the new.

Extreme maximum dimensions of the new building imposed by space limitations was 37 by 47 ft. The old one-story boiler house measured 40 by 60 ft. The limitations of the new floor space meant that we would have to restrict the dimensions of the firebox and increase the over-all height of the boiler.

The new building, therefore, was designed to be three stories high, with a partial basement underneath. Because of the required non-standard shape of the boiler's fire chamber — longer and narrower than usual — the stoker manufacturer was reluctant to supply a continuous cleaning-type stoking unit.

Soil Conditions Pose Problem

We were forced to provide a somewhat deeper basement than would otherwise be required in order to accommodate the type of equipment he deemed necessary. This headed us into still another problem — unfavorable soil conditions.

Our plant is located close to a river. Any excessively deep excavation would entail heavy expense, and construction would require sheet piling, which was provided. As the basement now stands its floor is below the water table. We have experienced no difficulty from this fact, however, undoubtedly because of the precautions taken when the basement was dug and constructed.

Once we found it would be possible to overcome these many problems and we began to build a boiler house of sufficient capacity to meet our needs, our greatest concern then became the matter of meeting the deadline that had been handed to us.

Actual construction work took on a particularly hectic aspect largely because of the low accessibility to the property. Getting the materials to the site was bad enough. But storing various construction materials and boiler house components as the work proceeded was even worse. There was little or no free space in which to put anything.

Construction of the boiler house and installation of the equipment was completed, however, in 10 months. The deadline was missed by only one month. The new facility was in com-

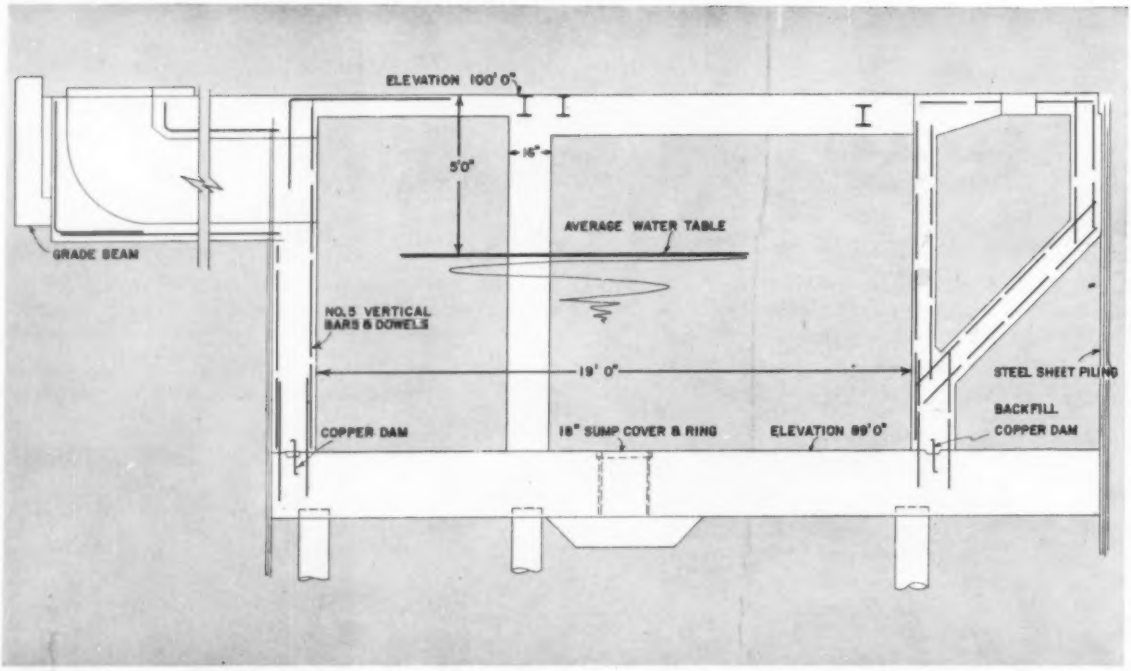


Fig. 6. Section of basement and foundation for power house addition; note level of water table. Pilings support footings

plete operation by November 1, 1954.

The interior layout provides five levels for the equipment, its operation, and maintenance. They are: partial basement; ground floor; mezzanine; boiler drum platform; and coal bunker walkway. (The coal bunker has a capacity of 125 tons, or two days' supply, at full load.)

Boiler provided is rated at 50,000 lb per hour. Such auxiliaries as pumps to feed our water heaters, etc., are of sufficient capacity to accommodate a second boiler which may in the future replace the old, original unit now in use as a standby. This of course means capacity of the boiler house can be doubled without dimensional expansion.

All components used are standard. Some of the old boiler house equipment is still being employed, but all of the newly-installed units, including ash-handling facilities, are the most modern available.

Although tailored to fit into an uncomfortably tight corner of our property, we find that our new boiler house is adequate to meet all requirements, and we have been told by numerous impartial visitors it is one of the neatest, most orderly layouts they have seen anywhere.

Above ground the building features interlocking pressed metal over a structural steel framework. Floors are of re-inforced concrete and steel grating. It has a standard insulated roof, topped with tar and gravel.

In dollars and cents, the complete job cost us $600,000. What it cost in sleepless nights and how much it taxed our ingenuity, however, can't be so readily estimated, so just let's leave that factor to the imagination.

Liquid Cools Largest Generator

FIRST LARGE STEAM turbine-generator with liquid-cooled stator conductors in the history of the electrical industry, made by General Electric Co.'s Large Steam Turbine-Generator plant, is now running at The Cleveland Electric Illuminating Co.'s station at Eastlake, Ohio.

The unit consisting of a tandem-compound turbine rated at 208,000 kw and its connected generator rated capable of producing 260,000 kva, will be the largest 3600-rpm turbine-generator in the world.

Innovation of circulating a cooling liquid through hollow conductors will be used in the stator portion of the turbine-generator. Most present-day generators are cooled by circulating hydrogen gas through passages in the magnetic portions of the rotor and stator.

Other technical features of the CEI generator include a gas-conductor-cooled rotating field winding, a new and improved grain-oriented strip steel in the magnetic portion of the armature, and an improved type of insulation.

Eva Can Spot Man 200 Yards in Darkness

UNIQUE INSTRUMENT which makes it possible to see in the dark was recently shown to the public for the first time by Baird Associates, Inc., Cambridge, Mass., an affiliate of American Research and Development Corporation.

The device, which utilizes no electronic circuitry, is called an evaporograph (nicknamed EVA), and enables one to spot a man 200 yards away or to see a house a mile distant in total darkness.

In operation, the evaporograph is similar to a camera. The unit collects radiation emitted from an object and focuses it as an image onto an oil film.

The oil then evaporates away from point to point at rates varying with the amount of radiation received at each point. Seen in reflected light, these differences in oil film thickness appear as different colors, like oil films on water.

A detailed thermal picture of the field of view is thus obtained in color. This picture can be viewed directly, or a photographic record can be made with a camera which is incorporated in the apparatus.

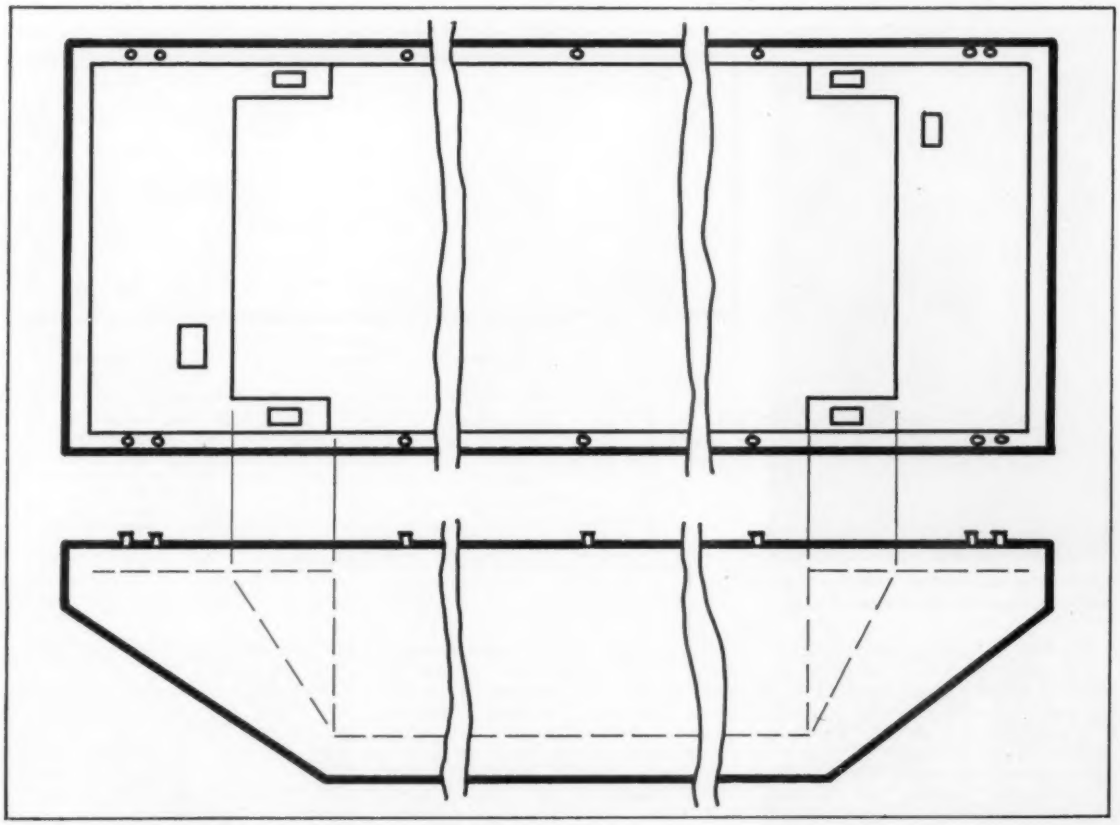


Fig. 1. General outline of the measurement arrangements of an average barge—typical of all such water-borne carriers

How Much Coal in That Barge?

Fig. 2. Gaging immersion depth by use of tube; note tube line-up with hatch

Scales big enough to weigh a coal-laden river barge are rather a scarce item in the trade; fortunately, the natural principles of buoyancy and displacement enable barge operators to use the craft itself as efficient weighing machine. Author tells trade tricks

By FRED M. REITER *

TONNAGE OF COAL transported by barge on the Ohio River and its tributaries has increased greatly in the past decade. This is a natural result of the construction of many large power-generating plants on or close to river unloading facilities. Although the selection of sites along these rivers stemmed chiefly from the need of large volumes of water, the possibilities of low-cost transportation of bulk material, such as coal, played a large part in the decisions.

This article is concerned with one of the most important phases of this mode of transportation: the determination of the amount of coal shipped in each barge. How many tons of coal are contained in the barge and finally paid for?

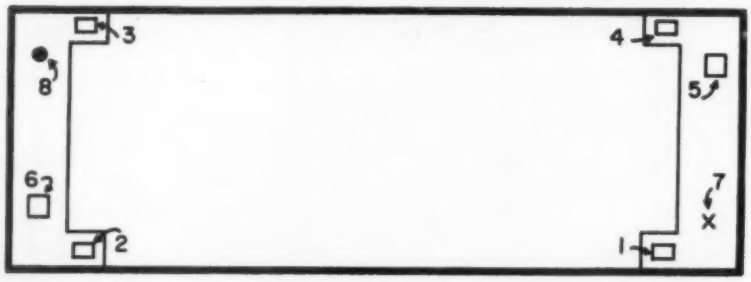
Several centuries prior to the Christian era, Archimedes explained the principles for measuring the weight of coal in barges. His principles of buoyancy and displacement form the basis of a very accurate means of determining the number of tons of coal in barges. Displacement measurements are taken of ocean shipments of bulk materials; the Plimsoll mark on the side of a ship serves as a displacement control point to indicate a vessel's loaded condition.

Archimedes' principle states that any floating body will displace a quantity of water equal to its own weight. A body, regardless of density, whether it sinks or not, is buoyed up by a force equal to the weight of the fluid it has displaced; this principle applies to the measurement of coal

*Formerly, Fuel Engineer, Dayton Power & Light Co.

Fig. 3. Gaging on river side of barge. With tube, ripples don't upset reading

Table I. Depth gage readings on typical barge. Sketch shows reading points



Position	Gage reading (inches) barge empty	barge full	Conditions inside of Barge bulkheads
1	9'5-¾"	36-¾"	⅝" dirt, no water
2	9'3	36"	1" dirt, no water
3	9'2	30-½"	4-½" dirt plus water
4	9'3-¾"	30-⅜"	4-⅜" dirt plus water
5	—	—	13-½" water plus dirt
6	—	—	7" water plus dirt
7	—	—	9-¼" water, no dirt
8	—	—	12-½" water plus dirt
Average	9.36 ft	2.43 ft	
Difference	6.93 ft		

in floating barges for power plants.

The gager need only measure the depth to which a given barge of fixed size and shape sinks, empty and full. It is just as simple as that. The only variable is the accuracy with which measurements are made. This method of measuring barges has become standard procedure among personnel known as "qualified gagers," men who specialize professionally in this work.

Gagers, however, are not licensed or registered in many states, nor are they licensed federally, as are the weighmasters of railroad and truck scales. Weighing scales are tested by the railroads, or the state, or the local Department of Weights and Measures. The lever systems of track and road scales remain constant in their adjustment, indicating or recording the weight of the load without the aid of man. Gaging of barges is entirely a human endeavor, and subject to human error. But by the development of standard methods, considerable accuracy and agreement among gagers has been established.

Gaging at Fixed Points

Figure 1 illustrates the plan view of a standard 1000-ton steel river barge used for transporting coal. Water depth measurements are generally taken along the gunwale, opposite the inside edge of the openings or covers of the entries into the inner chamber or bulkheads of the barges. Lining up with the inside edge of the bulkhead door opening provides a fixed point along the gunwales for all measurements. These points also bring the measurements within the area of the submerged portion of the hull, rather than into the rise of the angle of the ends of the barge that may be out of water.

Some gagers use a varnished measuring stick about 1-in. square in cross-section with notches cut in one side in fractions of an inch. This stick had its center of gravity well below the gunwale of the barge so that it assumes a plumb position freely. Other gagers use light folding-rules, but these may become top-heavy when the shorter depths of loaded barges are measured. When the rule is top heavy, it may go out of plumb and rest at an angle to the water other than 90 deg. Fractions of an inch difference in depth measurements can give variations in tons in measuring an area as large as the top of a barge.

Figure 2 illustrates the use of a sheet metal tube about 3 in. in diameter. This tube has a horizontal steel angle bar attached to its side, at an angle of 90 deg to its axis. This bar rests on the outer steel sheet of the barge side so that identical measurement levels are secured at all times by any gager. The top of the tube is 3 in. above the bottom of the angle cross bar, so that the reading of the measuring stick or rule made at the top rim of the tube is always made at the same point, and measures 3 in. above the actual top of the barge side wall. The measuring stick or rule is lowered to the water's edge inside the tube and readings taken against the top rim of the tube.

With this tube, there are several points on the steel sides on which readings could be made. Two sheets of steel plate form the outer shell of the barge at the gunwale; one is the actual shell, the other a reinforcing sheet. The actual shell sheet is generally used to sight the rule readings. One veteran gager would put the ball of his shoe across the sheets and measure to the sole of his shoe. (If his toes turn up, he might have a slight variation.)

An interesting item in taking readings is the point at which the rule or stick makes contact with the water. With practice this becomes simple, because at the moment of contact with the water, the stick breaks the surface tension film of the water, and the water wets the stick. Capillary attraction immediately causes a lift in the surface of the water against the stick. This is clearly visible in the reflected light.

The advantage of the tube is in securing a waveless water surface. On windy days, waves striking the side of the barge make it difficult to get the true water level that would compare with readings elsewhere or on still water days. It would be necessary to average a number of of readings. Figure 3 shows the measurements being taken on the river side of the barge with the tube submerged among the waves and ripples of the water surface.

Make Allowance for Bilges

In addition to reading the water depths off the sides of the barge, the gager must descend into the space between the inner wooden bottom of the coal holding chamber and the outer steel hull of the barge. Dirt, coal or water may accumulate within these inside compartments and affect the tonnage of coal computed for the load. It is customary to measure these extraneous contents each time readings are taken. Depths and areas of water, dirt, coal, etc., are measured and deducted from the measurement computations in order to have basically clean barges in all measurements.

All barges are pumped clear of water in the bulkheads when loaded

Table II. Example of an application of barge measurements to barge hull chart

	Length of barge coal compartment
At loaded water level	173.17 ft
At empty	156.58 ft
Average	164.875 ft
Width of barge	26.0 ft
Area of coal, average horiz. barge section	4286.75 sq ft
Cu ft volume per ft height	4286.75 cu ft
Weight, displaced water @ 62.5 lb per cu ft	267,921 lb
Displacement, tons/ft	134 tons
Actual uncorrected difference, full and empty	6.93 ft
Tons of coal in barge	928.62 tons

and initial measurements taken. Rain or snow in transit down the river may re-introduce water. Barges may be pumped out in travel or upon unloading. Hence it is essential to go down and measure the contents of the inner chambers in taking all readings.

Table I gives the displacement readings taken of a random barge, October 18, 1955, before and after unloading.

The manufacturers of barges make up complete displacement charts for each individual barge based upon their own construction, computations and tests. These charts go with the particular barge to the owner, for his own or the gager's use. The gager must have a set of these charts for every barge he gages in order to convert his measurements into tons. For example, if the barge of our example was Dravo Hull No. 1082, it might take Dravo Chart No. 21300.

No adjustment for the dirt, coal and water is included in the above basic figure. Volume adjustments require the barge construction data, from which the gagers determine their individual corrections, by methods of their own.

Different firms and gagers have their own developed and standardized methods, based upon the same general principles. Some firms have set up standard forms of their own for use by their gagers and for their permanent records.

There exists some difference of opinion as to the accuracy obtained with and without the help of the 3-in. tube. As a comparative test on this subject, our gager took readings with and without the tube. His point of measurement on the top of the tube was, in this case, 3 in. above the angle bar or top of the gunwale sheet on which the readings were made without the tube.

The results obtained by the two methods tabulate as follows:

Gaging Point	With Tube: Actual Reading	With Tube: Less 3-in. Tube Height	Without Tube: At Gunwale
1	39-⅜	36-⅜	36-¾
2	39-¼	36-¼	36-⅜
3	33-½	30-½	30-½
4	33	30	30-⅜

The only time when problems of the accuracy of barge measurements arise is when the coal from the barge is transferred to or from equipment that has weight scales, such as belts, railroad cars, trucks, etc.

New electrical belt scales can weigh the coal at the manual operating conditions at the rate of 250 tons per hour with an accuracy within 1 per cent. Recording and indicating meters are located 100 yards from the point of metering. Special precision rollers, belt-speed compensation by electric tachometer generators, strain-gage instrument resistance compensators, and other devices now give high accuracy.

Some checks were made on some coal delivered to our stations, comparing barge gage weights against truck scale weights. Over a period of six months on a delivery of 52 barges, a difference of 1.48 per cent was discovered for this period. Out of the 52 barges, 11 gaged under the truck scale weights, 39 gaged heavier and 2 were identical.

There are many factors involved in this difference, beyond the actual gaging at the loading tipple on the Kanawha River and the truck scales located near Dayton, Ohio, about 250 miles and five days later. Moisture loss by drainage and evaporation from the relatively large surface of the barge, from rain or snow, and other weather conditions, all enter the picture. Barges are completely emptied, so that errors of coal left in barges is nil. A man shovels the remaining small lots into piles which the crane bucket can lift out.

Shippers and receivers of large barge tonnages use electric belt weighing scales for the determination of the quantity of coal contained in the loaded barges. These are generally located at the loading point, so that this point becomes the official billing place, and its weights are officially accepted. They do not use gaged barge weights. Our own company purchases its coal on truck or rail car scale weights.

MSA's Commercial Smokescope

DESIGN AND DEVELOPMENT of more efficient combustion equipment and the use of smokeless fuels have been important factors in preventing air pollution. Air clean-up is still not 100 per cent effective, but progress in the control of smoke and air pollution has been made along many lines.

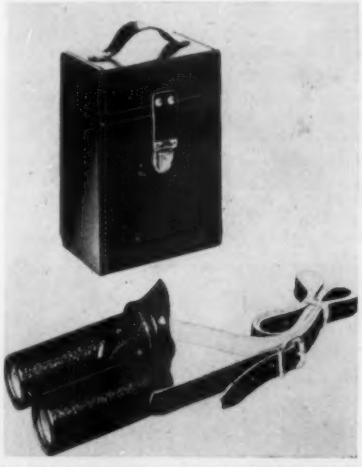
An outstanding example is the work of the research staff at Mine Safety Appliance Co., Pittsburgh. The company set out to develop an instrument that would serve as a comparator for industrial stacks and had as its goal a device which would satisfy these five requirements: 1. Results had to be correlated with those of the Ringelman chart because of existing legislation. 2. The instrument had to be convenient to use. 3. Variations in readings of the Ringelman chart that are produced by differences in the intensity and incidence of light upon the smoke plume had to be eliminated. 4. Variations in readings of the Ringelman chart that are caused by differences in illumination of the chart had to be eliminated. 5. The instrument had to permit comparison readings without forcing the observer to change the focus of his eyes, as is true with the Ringelman chart.

Incorporation of the principles of the Nyder gun sight in a viewer proved to be the key to the problem.

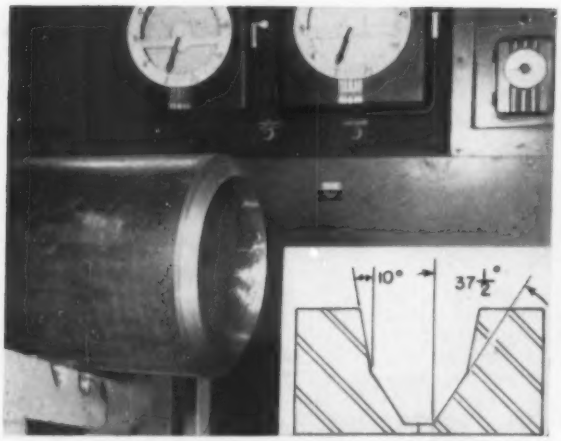
The image of two reference standards, shades 2 and 3 of the Ringelman chart, are projected into space adjacent to and in the same focal plane as the object of study. Reference standards were reduced from four to two when it became obvious that smoke densities greater than shade 3 violate all existing ordinances and densities less than shade 2 violate none of them.

The convenience of the commercial MSA Smokescope, plus the achievement of all objectives, especially that of reading smoke densities without changing the focus of the eye, outweighed the desirable but unessential correlation with all four Ringelman shades.

A drawing and description of the experimental model of the Smokescope were published on page 94, June 1953 issue of POWER ENGINEERING. The present instrument is fundamentally an improved version of the experimental model.



Instrument is size of small binocular



1 Before welding, pipe sections are machined to specified bevel to make ends suitable for inert-gas tungsten-arc root-pass technique. Pipe shown here is 1¼ Cr — ½ Mo

2 Solid, consumable insert ring with "positioner" pins on top and bottom of ring is inserted between sections; placement of this insert ring should be made very carefully

PIPE WELDING . . .

. . . Step-by-Step Picture Story

By HELMUT THIELSCH *

SOME OF THE major problems and disadvantages of inert-gas tungsten-arc root-pass welding of piping were discussed in the article "How Sound Are Inert-Gas Tungsten-Arc Root-Pass Welds?" which appeared in the April, 1956 issue of POWER ENGINEERING. A number of inquiries have been made regarding the method by which this type of welding is done.

This series of photographs illustrates the various steps followed in shop welding a particular piping material for a particular job. Actually, a great many different procedures have been suggested and have been used in shop fabrication. The most suitable welding and inspection procedure varies with each material and job, as well as with the facilities available. Procedures different from that shown here may be more practical under another set of circumstances.

For example, method of inspection shown here for examining soundness of root-pass weld (Figs. 11 and 12) is by dye-penetrant inspection; magnetic particle and radiographic techniques, however, are also occasionally used. Again, automatic submerged-arc welding is sometimes employed to complete remainder of weld after root-pass has been made. Figure 13 shows shielded metal-arc method in use for this purpose.

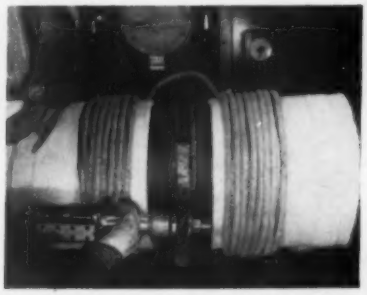
Other variations from practice illustrated here are furnace stress relieving instead of induction heating (Fig. 16), and X-ray inspection of completed weld instead of gamma-ray technique shown in Fig. 17. Techniques used will always depend on the job at hand and the facilities available.

*Metallurgical Engineer, Grinnell Co., Inc.

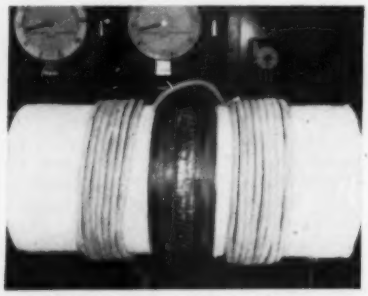
5 Set-up joint. Top of insert ring protrudes up into bevel; bottom of ring protrudes upward inside of pipe

9 Pipe is preheated to 550 F, then operation is begun with inert-gas tungsten-arc root-pass welding method

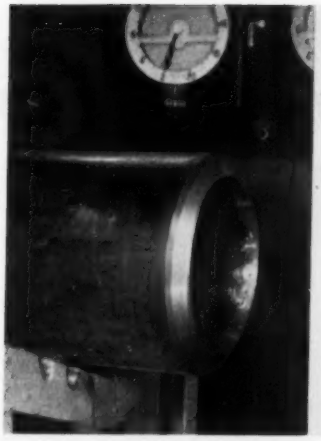
13 Remainder of weld is completed by shielded metal-arc welding. Submerged arc-welding can also be used

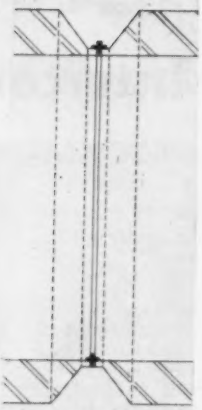


14 Between each pass of metal-arc weld, it is necessary to clean bead to assure sound succeeding layer



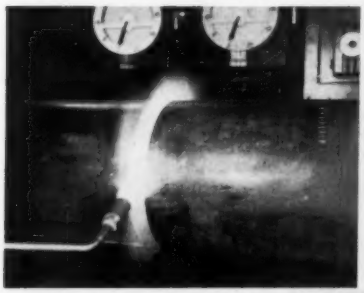
15 This is how the finished weld should look if all preceding operations have been carefully followed



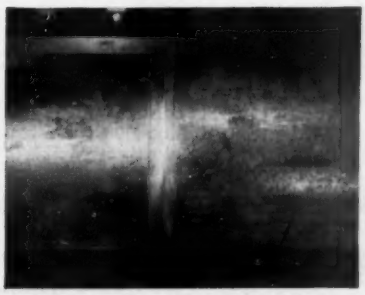


3 Insert ring is attached eccentric to pipe center-line as shown to compensate for sag of molten weld metal and to assist in obtaining crack-free weld, smooth contours

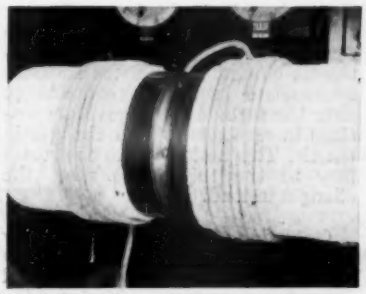
4 Next operation is placement of the purging fixture inside of pipe to provide inert-gas protection of the underside of the weld bead; this assures good weld inside



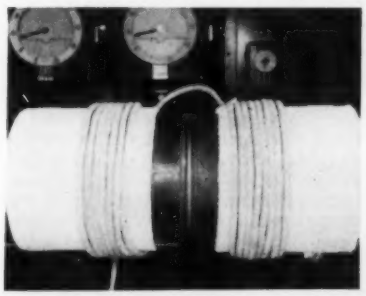
6 Pipe is then preheated at points where tack welds are to be made. These welds will hold ring in position



7 Tack-weld made by breaking an arc on bevel. With *solid* insert rings only two to four tack-welds are needed

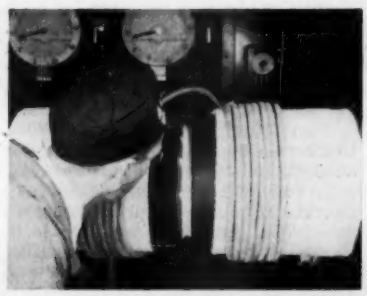


8 When tack welds are made, pipe is wrapped with asbestos, induction coils for preheating prior to welding

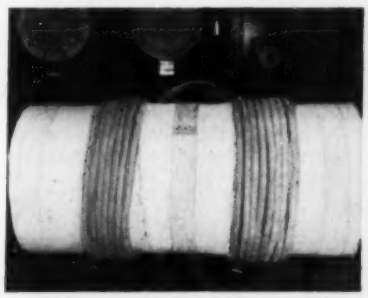


10 This photo shows the inert-gas tungsten-arc root-pass weld as it is completed, ready for inspection

11 Application of fluid for dye-penetrant inspection. Magnetic or radiographic tests can also be used

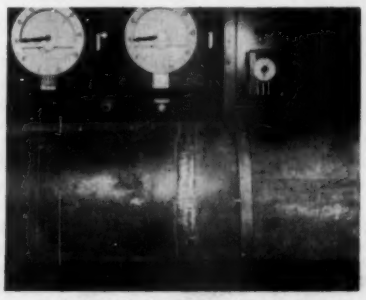


12 White powder developer film is examined for signs of center-line or crater cracks in root-pass weld



16 Stress-relieving by induction heating. For greater control of stress relieving, furnace is better

17 Gamma-ray inspection of weld. In shop fabrication, an X-ray technique of inspection would be made



18 Finished joint is banded with code, material, and job number; corrosion-resisting paint finishes job

Paper Mill and Utility Interconnections Raise

Last month, authors discussed reasons for installing a utility tie, switchgear, tie capacity, and generator control with a tie. Here they discuss control of real and reactive kva in the tie, effect of woodmill operation on the power purchase rate and the tie loading control

By H. A. ROSE* and H. E. SPRINGER†

CONTROL OF real power flow in the tie: The magnitude and direction of real power flow in the interconnection tie will usually be regulated by a condensing turbine generator operated on either manual or automatic load control. Automatic load control is obtained by a kilowatt load regulating device connected to current and potential transformers in the tie circuit. This device actuates appropriate secondary controls to alter the turbine speed governor settings in response to load changes in the tie. This action varies the steam flow to the turbine to meet the changes in load.

Operation of the system: It is only secondarily affected by extraction conditions, since steam not required for process purposes flows to the condenser. The turbine blade paths and the condenser area must necessarily have capacity to handle the quantities of steam required for both process and load regulating purposes.

Such load regulating systems can be used to hold purchased power constant or to limit it to a predetermined value.

Two principles may be employed to alter the speed governor setting for automatic load control purposes:

1. The load regulating device may operate the usual synchronizing or speed changer motor to increase or decrease governor spring tension, thereby altering the steam flow and power output of the unit (Fig. 5).

2. The load regulating device may operate an electric torque motor or solenoid to change the net effective speed governing oil pressure, thereby altering the steam flow and power output of the unit (Fig. 2).

The first system is particularly applicable to interconnections where load changes are gradual and not too large. If load changes are more violent and recurring, a high-speed, heavy-duty speed changer motor and governor-head mechanism will be required to obtain sufficiently fast operation and satisfactory apparatus life. This system is readily adaptable to old or existing turbines where moderate accuracy of load control permits its use. Provision must be made to prevent the speed changer motor from closing the steam valves in the event of a break in the power tie. Figure 1 shows a high speed rotating regulator applied to the governing system of a condensing-extraction turbine generator for constant kw tie line control to a pulp mill.

The second system is particularly applicable where load swings are fast and fairly large, or where a high degree of control accuracy is required. This system has the advantage of not disturbing the normal settings and functioning of the turbines' usual speed governor. In the event of a break in the power tie, the governor starts controlling at its normal preset full-load 60 cycle frequency.

In operation, the load controlling solenoid, Figs. 2 and 3, applies force to a governor oil pressure transformer cup valve. Very slight movements of this cup valve varies the governor's secondary control pressure, which acts on a servo-motor piston to adjust the admission valves that regulate the steam input to the turbine.

Since this device acts directly in the turbines' hydraulic speed control system, the response is essentially instantaneous and it consequently maintains accurate control of the tie line load.

To hold constant load (block purchased power) in the tie it is necessary that steam pass to the condenser during certain intervals. This condition prevails when:

Process kw Capability + Purchased kw < Total kw of Mill Load

Determining the block power rate: It is important to evaluate the net condenser heat loss during these intervals and balance it against the sale value of hogged fuel. This fuel if not burned or sold will accumulate. It will usually be advisable to contract for just enough power to keep waste fuels from accumulating.

Figure 4 shows the time intervals when heat is lost at the condenser because "electrical load" requirements exceed "process capability" plus "block purchased power." The intervals are also shown during which steam flows directly from boiler to process pressures, because "electrical load" requirements are less than "process capability" plus "block purchased power." The curves are not necessarily typical of continuous mill operation. They were assumed to illustrate the different conditions incurred when an approximate maximum value of block power (E_p) is purchased.

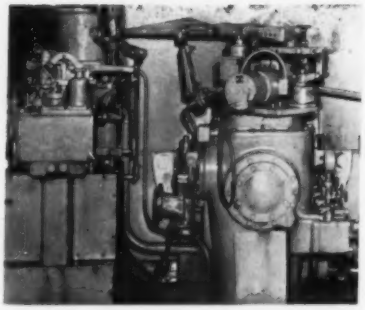


Fig. 1. High-speed rotating regulator on governor system of turbine generator for constant kw tie line load control

Mills producing ground wood pulp may regulate control of purchased power by a tie line regulator arranged to vary grinding stone pressures. Excessive short time load demands exceeding the correcting capability of the regulating system may be handled by automatically stopping a grinder or by opening nonessential load feeders.

Effect of Woodmill Operation on the Purchase of Block Rate Power: The base electric load for powering the pulp or paper producing portion of a mill is reasonably constant over a 24-hour period. The kw magnitude of block power that might be purchased for this portion of the mill's load is readily determined by the excess required above extraction capability of the turbine generators with allowance made for generation from necessary cooling steam. The economic feasibility depends primarily on the cost at which the mill can produce block power from condensing steam compared with the cost of purchased power. Figure 5 shows this block of power for a 24-hour period as E_b.

The load of the wood preparation plant, however, is quite variable because of the nature of the work done and the types of machines required to reduce the logs to suitable form for process purposes. The woodmill is also usually operated one or two 8-hour shifts per day with time out for lunch and relief periods, changing band saws, chipper knives, etc. The character of the load is partially illustrated as 2500 KW blocks of power for 4-hour intervals in Fig. 5.

Separate consideration must be given this load to determine if it can

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and Solve Some Problems—II

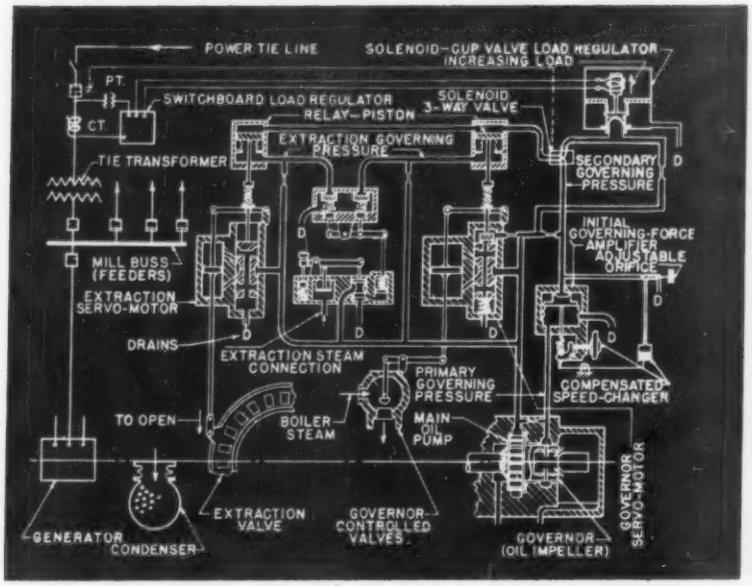


Fig. 2. Above. Hydraulic speed control system for condensing-extraction turbine for constant kw tie line load control

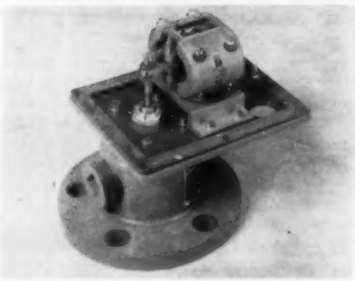
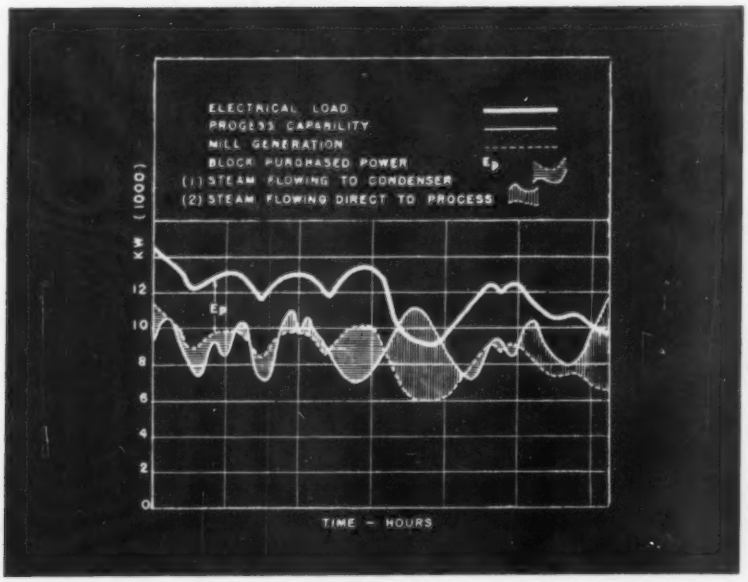


Fig. 3. Left. Electric solenoid cup valve regulator shown in diagram in Fig. 2

Fig. 4. Below. Power diagram for a pulp mill when block purchased power is close to its maximum economic value



be economically purchased. Many factors will enter the determination. The relative costs for purchased power at fixed demand should be compared with variable gross power schedules of limited and unlimited demand. These should be compared with the mill's cost to carry the load on condensing steam.

To illustrate the character of the woodmill load as affecting economical purchase of power, a typical case is assumed. Power cost data, load values, and days of operation are given by Figs. 5 and 6. Eight-hour and 16-hour woodmill operation are considered. Fig. 6 shows the incremental woodmill cost for purchased power plus condensing power, as the mill's total block purchased power is increased from the 14.5 kw (E_b = 3000 kw) to the 17.0 kw level.

It is important to note that 8-hour woodmill operation on condensing power costs considerably less than 16-hr. operation on block purchased power. Also, if 16-hr. operation is required, it is more economical to purchase the 2500 kw woodmill increment continuously, E (16 hr.) even though it is not all consumed. If 8-hr. woodmill production will suffice, the 2500 kw increment should be generated from condensing steam and no additional block power purchased.

Control of Reactive Power in the Tie: The operating power factor of pulp and paper mills is usually 80 to 95 per cent. Good power factor is becoming increasingly important to both the mill and the utility. The power contract will probably inflict penalties for average or short-time power factor below specified values. It is therefore important that the power tie connection be properly coordinated with the mill's circuits so that adequate control of power factor can be assured.

When two independent sources of generation are to be connected, differences in normal operating voltages at the tie point are likely to exist. It is essential that the tie transformer have suitable range of voltage taps above and below the normal value, so that the connection can be made at essentially zero voltage difference. The transformer should be provided with a no-load type of tap changer, for manual operation from outside the transformer case.

If this is not done, the system with highest voltage will deliver reactive power to the other, thus altering the normal (unity) power factor state of the tie. The magnitude of this reactive interchange will be proportional to the voltage difference. The condition of unity tie power factor means that the mill is carrying its own reactive load and the utility is doing likewise.

The power contract may provide for the utility to carry a portion of the mill's reactive load. To accomplish this it becomes necessary to raise the utility's input voltage

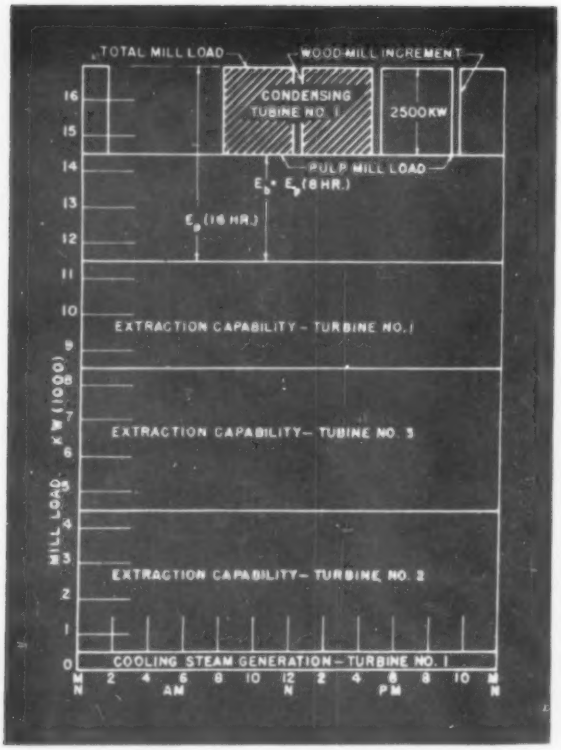

TOTAL MILL LOAD
WOOD-MILL INCREMENT
CONDENSING TURBINE NO. 1
2500 KW
PULP MILL LOAD
$E_p = E_p$ (8 HR.)
E_p (16 HR.)
EXTRACTION CAPABILITY - TURBINE NO. 1
EXTRACTION CAPABILITY - TURBINE NO. 3
EXTRACTION CAPABILITY - TURBINE NO. 2
COOLING STEAM GENERATION - TURBINE NO. 1
MILL LOAD KW (1000)
M N 2 4 6 8 10 12 2 4 6 8 10 M N
AM N PM

Fig. 5. Power diagram for a pulp mill showing average load division between generators based on data shown in Fig. 6

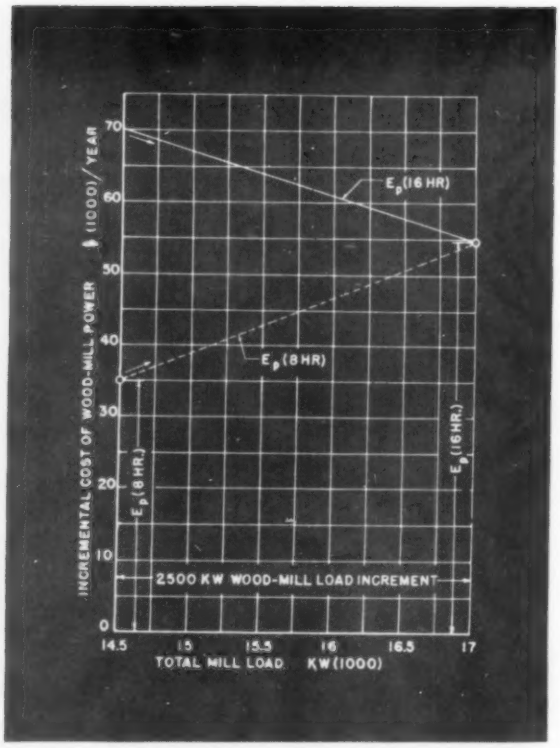

INCREMENTAL COST OF WOOD-MILL POWER $ (1000)/YEAR
E_p (16 HR)
E_p (8 HR)
E_p (8 HR.)
E_p (16 HR.)
2500 KW WOOD-MILL LOAD INCREMENT
14.5 15 15.5 16 16.5 17
TOTAL MILL LOAD KW (1000)

Fig. 6. Variation in cost of purchased power plus cost of condensing power to carry 2,500 kw woodmill loads of Fig. 5

through the tie transformer, or to lower the mill's bus voltage a like amount.

It is very undesirable for the mill to operate at subnormal voltage. Normal bus voltages insure most reliable operation of the large amount of electrical apparatus; most efficient operation of the many motors is obtained. Maximum mechanical output and product producing capability is also assured. Low voltage conditions are often associated with poor power factor or with poor facilities for proper control of reactive power.

If the tie transformer has been provided with an adequate range of voltage control taps, it will be possible to choose one that will produce the proper directional flow of reactive power and still allow the mill generators to operate at essentially normal bus voltage. Slight changes in generator voltage can then be made to keep the tie power factor within prescribed limits.

For best operation, mill generators should have their voltages controlled by individual modern voltage regulators with cross-current compensation to insure proper division of reactive load between machines and to improve their load-carrying capabilities.

A power system which delivers low voltage at the tie point during its heavy-load periods sheds its reactive to the mill generators, thus reducing their real load capacity. To alleviate this situation without lowering generator bus voltage it becomes necessary for the mill to either:

1. Carry the additional reactive through the peak with its normal-load generators.
2. Place additional generators on the bus to alleviate the overloaded condition.
3. Split the mill generating circuits, placing the tie on unessential mill load and operating isolated on the essential portion.
4. Disconnect the tie long enough to change transformer taps.

Similarly, a system which delivers high voltage can absorb more than normal amount of the mill's reactive load and becomes responsible for the mill incurring low power factor or reactive demand penalties.

Well-regulated heavier power system circuits usually have sufficiently well-maintained voltages to permit setting the tie transformer on an intermediate tap between the high and low voltage extremes. For such systems, only slight changes from normal generator voltage are required for adequate reactive load control.

For such systems, tie-line reactive load regulators or load limit controllers may be used in conjunction with the generator voltage regulators to automatically hold the reactive power within prescribed limits. The controls should be arranged to become inoperative when the bus voltage reaches predetermined values. Otherwise, abnormal load conditions may result in excessively high or low mill voltage, with the regulators attempting to hold the tie-line reactive load within the prescribed limits.

Where interconnections are made to weak or poorly regulated power circuits, or to major systems subject to wide voltage fluctuations, it may be necessary or desirable to supplement the tie transformer with tap changing underload equipment. With this equipment the generator busses may be operated at normal voltage and the tie line allowed to vary in conformance with the system's operating characteristics.

The tap changer position may be automatically controlled to regulate the flow of reactive power in the tie, or to limit it to zero value.

A mill having limited fuel supply but ample reactive (kvar) generating capability might advantageously purchase real (kw) power and simultaneously assist the utility by supplying it reactive power for improving system voltage and stability. The fact that the directions of real and reactive power flows are in a sense reversed to each other in the tie, does not prevent satisfactory and automatic operation with this arrangement.

Regulators for Controlling Real and Reactive Load in the Tie Circuit: The real and reactive load regulators usually form a section of the mill's main switchboard. The regulators' load sensing elements are energized by current and *continued on page 102*

Germanium Rectifiers . . . . What You Need to Know

Most power engineers are familiar with copper oxide and selenium rectifiers. More recent type is the Germanium Rectifier. Its remarkable properties—some good; some bad—are described here

GERMANIUM rectifiers have characteristics that differ sharply from other types of metallic rectifiers, as the following comparisons will show:

Selenium and copper oxide rectifiers use large rectifying areas, operating at low current densities of the order of 0.3 amp per sq in. These low current densities mean that for large current and power values large cell areas and large stack assemblies are necessary. The large areas, however, provide a simple means of dissipating the heat where it is generated, i.e. at the junction between the copper and the copper oxide, and may also provide large thermal capacity to take care of any current surges or short time overloads.

Thus we can say that selenium and copper oxide rectifiers are rectifying devices of large area, low current densities, capable of absorbing short time surges and overloads, and having well established operating characteristics.

Details of Rectifier

In contrast, the germanium rectifier is a rectifying device of small area, very high current density, low thermal capacity, and is susceptible to voltage and current surges.

The germanium rectifier operates at current densities of several hundred amps per sq in, and though it is remarkably efficient, this still means that a lot of heat has to be dissipated per unit area.

The germanium crystal itself is a small wafer, 0.02 to 0.03 in. thick and up to 1 in. diam, although most of the rectifiers for power applications use a crystal about ½ in. diam. The crystal becomes part of a sandwich, soldered between two metal plates which become collectors. A technique has now been developed for soldering the germanium crystal directly to copper so the metal plates are usually made of copper for good cooling action.

Various methods of cooling are used. For low power, forced air cooling is often used, while liquid cooling is used for large power applications.

A list of the advantages and disadvantages of the germanium rectifier would read something like this:

Advantages: a. High operating efficiency, b. Very good regulation, c. Small size, d. Low forward resistance, e. High reverse resistance.

Disadvantages: a. Low thermal capacity, b. Temperature limitations, c. Susceptible to current surges, d. Susceptible to voltage surges.

One of the outstanding advantages of the germanium rectifier is its high operating efficiency of 98 per cent for the cells with an overall equipment efficiency of 94 to 95 per cent at 65 to 75 volts d-c from a 3-phase power supply. The low forward drop gives very good regulation. However, these good characteristics have their corresponding disadvantages where a number of cells are to be used in parallel at high current outputs.

Under these circumstances very close matching and grading of the cells is necessary to ensure equal load sharing. A small resistance could be added in series with each cell, but as this would lower the efficiency, careful selection of the cells is preferred.

Pros and Cons of Small Size

The advantage of small size for the germanium cells also carries its disadvantage in terms of small thermal capacity. The overload capacities of the cells can be very accurately calculated and verified by laboratory tests. As an example, a cell with a normal rating of 250 amp peak could carry up to 900 amp for 1 sec or 2500 amp for 0.4 sec. A cell assembly with less efficient heat transfer would naturally have less overload capacity.

The limited thermal capacity of the germanium cell brings up the problem of protection. Standard fuses or circuit breakers operate too slowly to protect the cells. Also, with a group of cells operating in parallel, if one should fail, the others would feed excessive current into the faulty cell and damage themselves long before a fuse or circuit breaker could save them.

The solution to this problem has been to have a separate fuse for each cell, and a fast-acting current-limiting fuse has been developed for this purpose. Satisfactory operation is also possible with two cells in parallel with one fuse.

Cell Protection

Another characteristic of the germanium cell that has to be considered is the fact that the cell will be destroyed if transient voltages exceed the peak inverse voltage of the cell. Since almost any system on which germanium rectifiers are used will sooner or later have these voltage transients, steps must be taken for cell protection.

Two methods are usually employed. One is to assign a voltage rating to the cell to take care of normal conditions. These surge voltages can run to three times the working peak voltage. The other approach is to absorb the transients by means of capacitors.

It is also very important not to exceed the safe working temperature of the cell since the peak inverse voltage of a germanium cell decreases as the temperature rises, so there is danger of failure if the cell is operated above rated temperature rise.

How to Design

Thus we may summarize as follows the conditions that have to be considered in designing and applying germanium rectifiers:

1. The short circuit overload current to be expected.
2. The time the cell must stand this overload before the protective devices operate.
3. The steady state forward current.
4. The applied inverse voltage the cell must withstand.
5. The transient voltage the cell must withstand.
6. The maximum ambient temperature at which the cell must operate.

Table 1, a listing of some of the applications of germanium rectifiers installed, or being installed, will indicate the extent to which these rectifiers are now supplying d-c power to industry. Experience is confirming the view that germanium rectifiers are very suitable for industrial applications where power requirements are large, the output voltage comparatively low, and high operating efficiencies are desirable.

The information in this article is based on a paper by L. W. Burton of General Electric Company, presented at the AIEE Winter General Meeting 1956.

"Nutty, nothing! That generates sufficient power for his hearing aid!"

How Dirt

Understanding the mechanisms by which dirt cuts and grinds a journal bearing surface will help you take proper preventive measures to protect your own bearings from expensive damage

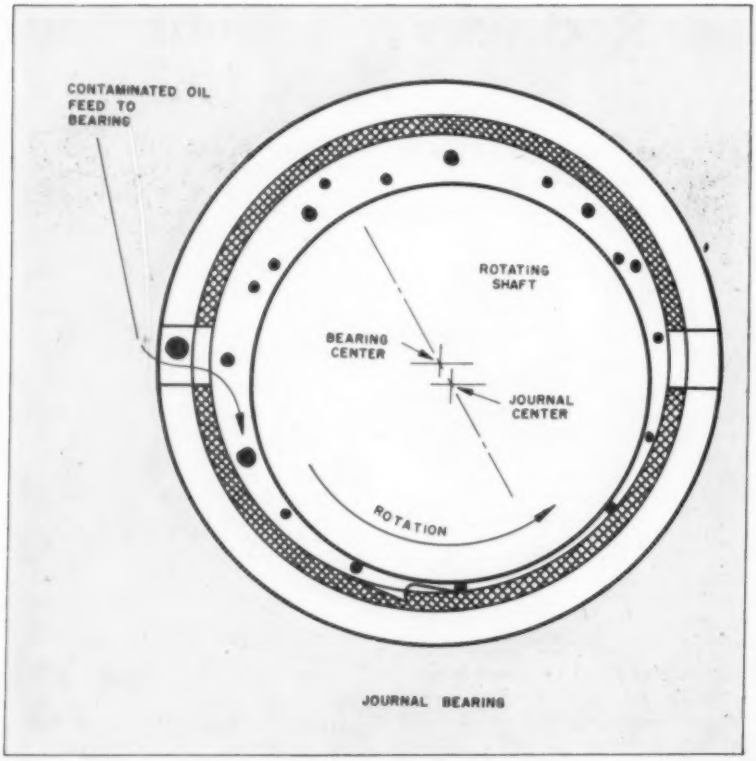


Fig. 1. Showing how minimum clearance between shaft and bearing determines smallest particle that can pass round bearing without cutting or grinding

MANY CASUALTIES among journal bearings are caused by contaminants in the lubricating oil. The cost of money and effort to keep out contaminants is a small fraction of the cost of replacing or repairing a machine immobilized by bearing damage. The purpose of this article is to show why contaminants have such severe damaging action. A subsequent article will explain how to keep them out of the system.

First, what is a contaminant? A contaminant in lubricating oil may be defined as any substance that the oil refinery did not put there for a specific purpose. Let us consider the most common offenders and see what effect they have.

Take water first. Oil and water form an emulsion, which consists of globules of one liquid mixed in with the other. The water globules displace the oil and break the protective lubricating oil film that is necessary

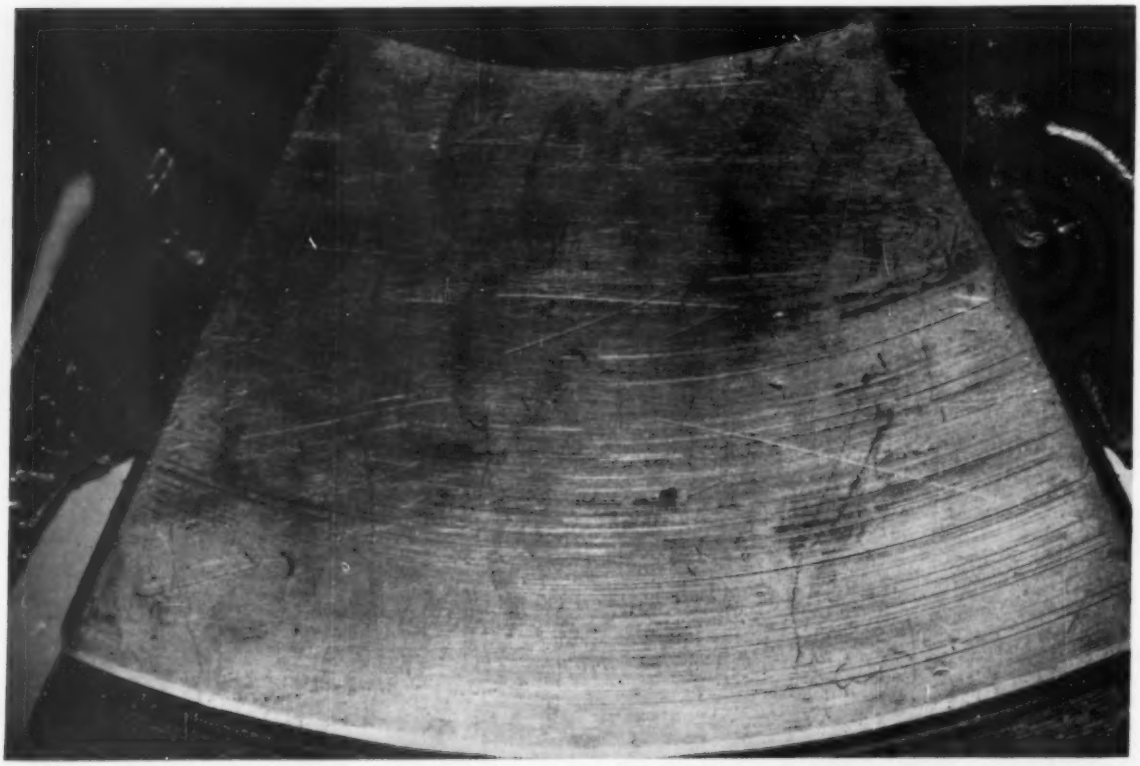


Fig. 2. Damage to thrust bearing shoe after 3 hrs operation with dirt in oil system. Surface was smooth at the start of run

Sabotages Your Bearings

for bearing protection. This allows metal to metal contact and consequent damage. Furthermore, the water causes rust, causing the smooth bearing surface to become pitted, while the rust particles circulate through the oil as an effective abrasive.

Probably the most frequent — and the worst contaminant — is the small piece of grit or abrasive particle that floats along with the oil and cuts and grinds away at bearings and journals and metal parts with which it comes in contact.

An understanding of the effect of particle size will help to explain the cutting action of abrasive particles.

Figure 1 shows a diagram of a shaft rotating in a bearing with clearances exaggerated for the sake of explanation. It will be seen that the oil film clearance is smallest in the vicinity of A, where the rotating shaft approaches closest to the bearing, and that at other points round the bearing the oil film clearance is greater. This means that a particle that can pass between shaft and bearing at point A can float freely in the oil at other points.

If the particle is too big to get past the shaft at point A it will cut or grind a channel in the bearing and/or shaft. If it is just a little bit bigger than the clearance it may cut a groove in the bearing or shaft and then continue on in the oil. If it is quite a bit bigger than the gap it may become embedded in the journal at the point A. Some particles get crushed at this point, but the action of crushing usually damages bearing or shaft or both.

Thus we see that the size of the oil film clearance at point A gives us a measure of the largest size of particle we can tolerate without damage to the bearing. If the particle is smaller than the clearance at A it will float along in the oil film without damaging the bearing or shaft. If it is larger than the clearance it will cause damage.

Oil film clearances can actually be measured quite accurately, and for a typical feed pump bearing at full speed the minimum oil film thickness is slightly less than one thousandth of an inch. This means that for this particular bearing, particles would all have to be less than .001 in. if they are not to damage the bearing surfaces of the pump.

However, even if all the particles are less than 0.001 in. there is a further complication, since the oil film clearance falls off sharply as the machine slows down, so that when the machine is starting and stopping, any particle, however minute, will be too big to get through the gap and so will damage the bearing. This is what actually occurs in practice and most of the wear on a bearing does occur during starting and stopping. If a machine did not have to stop it could run practically indefinitely without bearing wear provided the particles were smaller than the minimum oil clearance.

However, since machines do have to be started and stopped, this information shows that there are two ways in which wear can be reduced. One is to reduce the number of particles in the oil and the other is to reduce the size of the particles that cannot be eliminated. Reducing the size of particles means that the particles are cutting and grinding for a shorter time whenever the machine is started and stopped and so the amount of wear will be reduced.

A justification might be made on the grounds that most bearings are made of babbitt or other soft metal for the express purpose of enabling the particles to embed themselves in it and so to keep them out of the oil stream. Up to a point this is true, and babbitt does fulfill this function. However, it can absorb only a limited amount of grit before it becomes a kind of lapping block. (To take the extreme case, a grindstone is little more than a collection of abrasive particles embedded in a soft holding medium.)

Theoretically all large particles could be removed from an oil system by continually changing bearings until all large particles had been embedded and removed, but obviously this would not be a practical system. The truth is that we do not want *any* particles embedded in the bearing, and if we do have to have them we try and limit them to as small a number as possible.

Figures 2 and 3 show clearly the very real grinding action of dirt in lubricating oil.

Thus we can sum up by saying that the only way to avoid bearing damage by contaminants in the oil is to keep contaminants out of the oil, and if we cannot do this completely we must keep the contaminants as small as possible.

The above information is based on an article by George C. Ambler in a recent issue of the Bureau of Ships *Journal*.

Our definition of contaminant, as given at the beginning of this article, was any substance the oil refinery did not put into the oil for a specific purpose. This means that the contaminant gets into the oil after it leaves the refinery. So the next problems to discuss are how these contaminants get into the oil and what we can do to keep them out.

These two problems will be discussed in a future article.

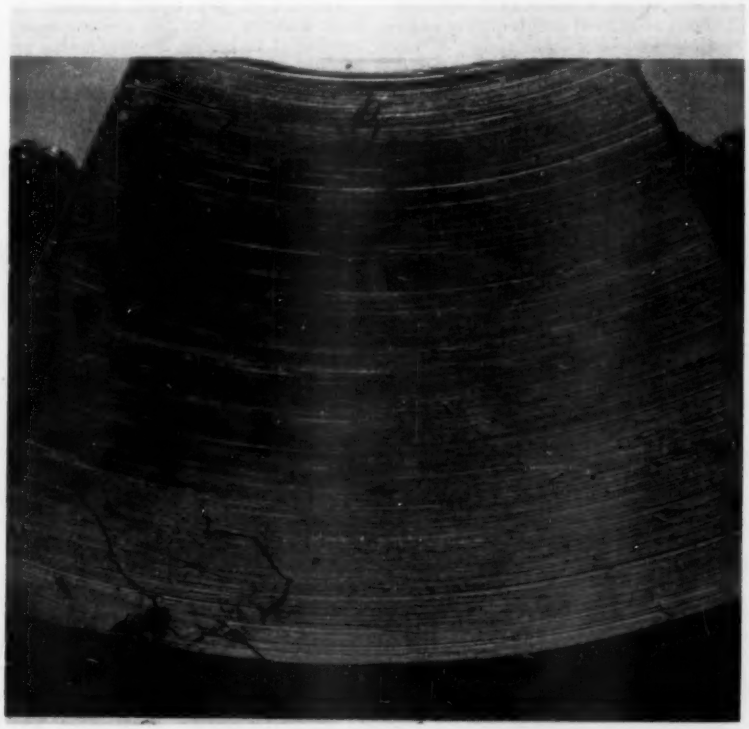


Fig. 3. Thrust bearing shoe shown in Fig. 2 after 9 hrs operation with dirty oil

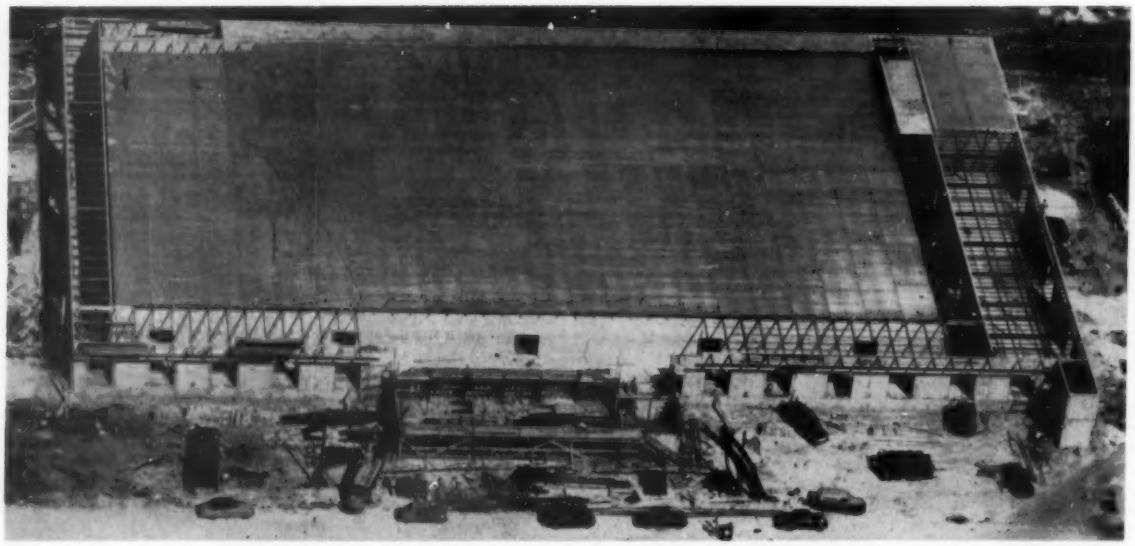


Fig. 1. Zero Food Storage's plant under construction in Miami, Fla. Vast rectangle under roof is the freezer storage room. It is surrounded by air lock, or corridor, 12 feet wide. Doors to this corridor fit truck end, forming seal

Sherman Put the Deep Freezer on Deep Sand

Special freezer plant foundation on 3 ft of sand seals off ground water, also insulates. Cantilevered roof moves to allow 2-in. steelwork contraction when freezer area temperature goes to −10 F

THIS RECENTLY completed freezer storage plant in Miami, Florida, offers a successful solution to the problems of architectural engineering for such specialized structures. A unit in the Zero Warehouses, Inc., chain, the building was designed by M. Tony Sherman, architects and engineers, of Miami.

Instead of the usual problem of frost danger under the freezer floor, causing it to heave, Sherman was up against ground water. Water temperature was 75 degrees at 20 ft down and 88 degrees at 6 ft below the surface of the top soil. Putting a freezer plant into such terrain would have been like dropping an ice cube into a tall drink on a hot day.

Sherman's solution was simple, and would seem to have possibilities for northern as well as southern sites.

The key was to seal off the water from the foundation and floor. Step one was to pour the footings and

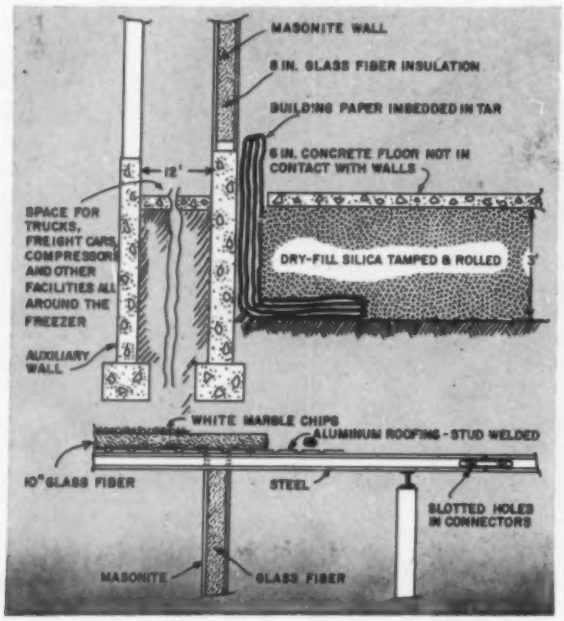


Fig. 2 (Left) — Foundation and roof construction help building beat problems connected with insulation and contraction

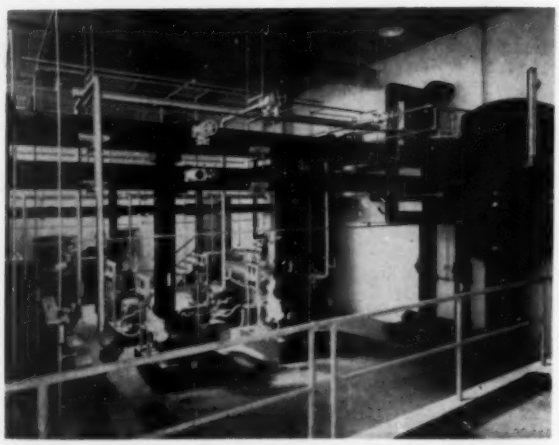


Fig. 3. View of compressor room. Four compressors keep plant at capacity, but installation includes seven units as well as a diesel generator used for stand-by power

Fig. 4. Roof is free to move because double cantilever steel framing carries the weight through slots in the walls

Fig. 5. Roof decking is corrosion-proof aluminum insulated with 10 in. of fiberglas topped with white marble chips

build the walls that would enclose the actual freezer area, and roof it over. These footings were of lightweight aggregate mixed with thermal resisting concrete.

Step two was to install a waterproof membrane (Fig. 2), built up to seal off the entire foundation area within the freezer plant walls from underground water seepage. This membrane was made up of several layers of vapor barrier building paper embedded in tar. The membrane was built up on the sides of the walls in a technique similar to that used to keep water in a swimming pool. All this work was done under roof and kept dry.

Step three was the use of an insulating fill of dry-fill silica 3 feet deep, as a bed for the 6-in. concrete slab floor of the freezer area. The sand was tamped, packed and rolled down to eliminate air pockets. The freezer room floor floats on this base, permitting any expansion or contraction of the walls. Finish walls of the freezer and storage area are Masonite over 8 in. of fiberglas.

As Figs. 4, 5 and 6 show, the problem of contraction of building elements from the cold temperatures within the freezer area is further met by constructing a roof that does not bear on the walls. Double cantilever framing construction supports the roof. In the insulated area, framing connections have open joints with slotted holes to allow any roof movement to be localized by sections. Thus roof weight does not bear on the walls but moves through the slots in the walls. That part of the roof on the overhang of the cantilever helps to pull the roof up over the freezer area that shows in Fig. 1.

The plant has a 120-ton total capacity in 7 compressor units, Fig. 3.

Fig. 6. Shooting special studs used in roof construction. Open joints with slotted holes (right) permit movement

Fig. 7. Freezer storage room is 222 by 164 ft, is kept at—10 F. Finish walls are Masonite over 8 in. of fiberglas

Feedwater Heater Package—New Way to Simplify the Steam Power Plant

To present a new approach to this ever-urgent problem the authors present two alternative methods, both of which combine regenerative feedwater heaters in a single shell. One integrates the closed-type heat exchangers; other employs a new method of using open-type heat exchangers with intermediate locks. Authors claim that a saving in initial investment of from $10 to $15 per kilowatt results

By H. A. KULJIAN* and W. J. FADDEN, Jr.†

EQUIPMENT in a steam power plant can be classified under three major groups; namely, the steam-generating unit, the turbine-generating unit, and the heat exchangers. All other equipment is either used to interconnect these, or contribute to their operation.

Steam-generating unit includes economizer, air preheater, waterwalls, superheater, forced-draft fan, induced-draft fan, pulverizers and furnace, in addition to the boiler itself. All these are fairly compact in arrangement.

Turbine-generating unit includes the condenser and controls, and it, too, is very compactly arranged.

But by contrast, the heat-exchanger equipment in a multistage bleeding installation usually includes several low-pressure heaters, a deaerating heater, high-pressure heaters, boiler feed pumps, and endless piping located where it can be squeezed in.

Importance of heat exchangers in attaining high thermal efficiency in modern plant operation is well known to all engineers.

While the supercritical-pressure stations constitute a radical change in power-plant practice, by far the greatest change now imminent is the use of nuclear energy for generating electric power. Naturally, more complex equipment will be added. It is, therefore, of paramount importance that the feedwater heating cycle be kept as simple and as effective as possible.

Take, for example, a 150,000-kw unit. The condenser, with approximately 100,000 sq ft of condensing surface, is manufactured in a single shell. For the same size unit, eight single-stage heat exchangers are used, with a combined total heating surface of less than one half that of the condenser.

Basic concept of incorporating all the stages of feed-water heating in a single compact shell is intended to reduce costs by:

(a) Requiring greatly simplified piping
(b) Reducing the number of engineering drawings
(c) Reducing installation cost and time
(d) Reducing building volume, particularly valuable floor space

In the aggregate, these four economies indicate a total saving of from $10 to $15 per installed kilowatt.

Two types of combined heaters are offered for both power plants and industrial plants: The closed heater, referred to as Type K feedwater; the open heater, called Type K-F.

These two new heater assemblies were described by the authors in Paper No. 56-5A-34 presented before the ASME 1956 semi-annual meeting at Cleveland.

Type K Feedwater Heater

Type K feedwater, Fig. 1, is basically a series of closed shell-and-tube type heaters that have been combined in a single vertical shell, and factory-built and tested as a single unit. Flow is accomplished by pumping feedwater directly from the condenser hotwell through the coils of the stages directly to the suction of the boiler feed pumps.

The suction-head requirements of the boiler feed pumps are satisfied by proper selection of the discharge pressure of the condensate booster pump. The tubes carrying the feedwater are arranged in flat spirals in the horizontal plane, and of such a size and number as to give the best heat transfer. Steam bled from the turbine at the desired point passes around these tubes to raise the temperature of the feedwater to the boiler and raise the overall thermal efficiency of the power plant.

Figure 1 and the accompanying description are based on a 150,000-kw turbine-generator, 2000 psig, 1050 F, 1000 F reheat, with 8 stages of extraction heating.

Type K feedwater heater, with its spiral-wound heat-exchanger tubes, consists of a tower-like, cylindrical shell partitioned into stages, one stage for each heater.

This assembly stands vertically on the condenser floor, as in Fig. 3, as close to the turbine generator as possible, with the highest-pressure stage at the top. Condensed extraction steam is cascaded from each stage heater to the next lower pressure unit. The condensate level in each stage is maintained with a level-control valve.

Accumulated extraction condensate from the lowest pressure stage heater is pumped into the inlet manifold, combining with the condensate booster-pump discharge. The stage-heater vents are also cascaded from one unit to the next lower pressure unit, finally cascading to the condenser.

Condensate from stage heaters, as well as from main condenser, enters the lowest pressure stage-heater manifold at the bottom. It then passes through a number of parallel coils into another manifold, which becomes the inlet manifold for the next higher pressure stage heater.

These manifolds are entirely internal and are welded to the partition plates at one point only, to allow free expansion of the manifolds and coils without causing any appreciable stress. The remaining stages operate in a similar manner.

In high-pressure stages of the feed cycle, energy is kept at the highest possible temperature level by use of desuperheating and drain cooling-zones. In drain cooling, entering feedwater picks up heat from the leaving condensate before it is flashed to the lower pressure heater and releases its heat at a lower temperature. The feedwater temperature is thereby raised a few degrees that it could not realize from the same heat in the lower pressure heater.

In the desuperheating zone, the leaving feedwater picks up heat from the incoming superheated steam, thereby raising the water temperature higher than the saturated steam temperature corresponding to the pressure. The K feedwater heater includes both drain cooling and desuperheating zones as required.

Cycle efficiencies obtained by using the type K feedwater heater are equal to those obtained by using conventional regenerative cycles.

Type K-F Heater

New Type K-F feedwater heater uses standard tray-type open heaters and deaerating heater, as now manufactured, which are combined in a vertical tower. Cross-section and details of this heater, given in original paper, are not shown here.

Flow from one heater to another is accomplished by gravity through a novel arrangement of receiving and discharging locks. A pair of locks is interposed between each two heating stages. One lock is steam equalized to the heating stage immediately above and receives water from that stage by gravity flow. The other lock is steam equalized to the next heating stage and discharges water by gravity to that stage.

When a lock is emptied and the

*President and †Chief Engineer, The Kuljian Corp., Engineers

other is full, a transfer valve is automatically operated to interchange the functions of the locks so the full one discharges to the high-pressure stage and the empty one receives water from the low-pressure stage.

This operation continues with a frequency of transfer as required by the boiler load.

By this means water flows from the low-pressure stage to the high-pressure receiver without requiring pumps.

Direct-contact heaters remove all dissolved oxygen in excess of 0.03 ml per liter. When such a unit is designed to reduce the dissolved oxygen to 0.005 ml per liter, it becomes a deaerating heater.

In the Type K-F heater, feedwater is fed into a series of trays and falls from tray to tray by overflowing. Steam completely envelops the trays, and heats and deaerates the feedwater along its path to the bottom of the shell.

The K-F feedwater-heater-tower assembly is also a completely factory built and tested unit. It starts with the lowest pressure heater at the top, progressing downward to the highest pressure direct-contact heater and finally to *continued on page 104*

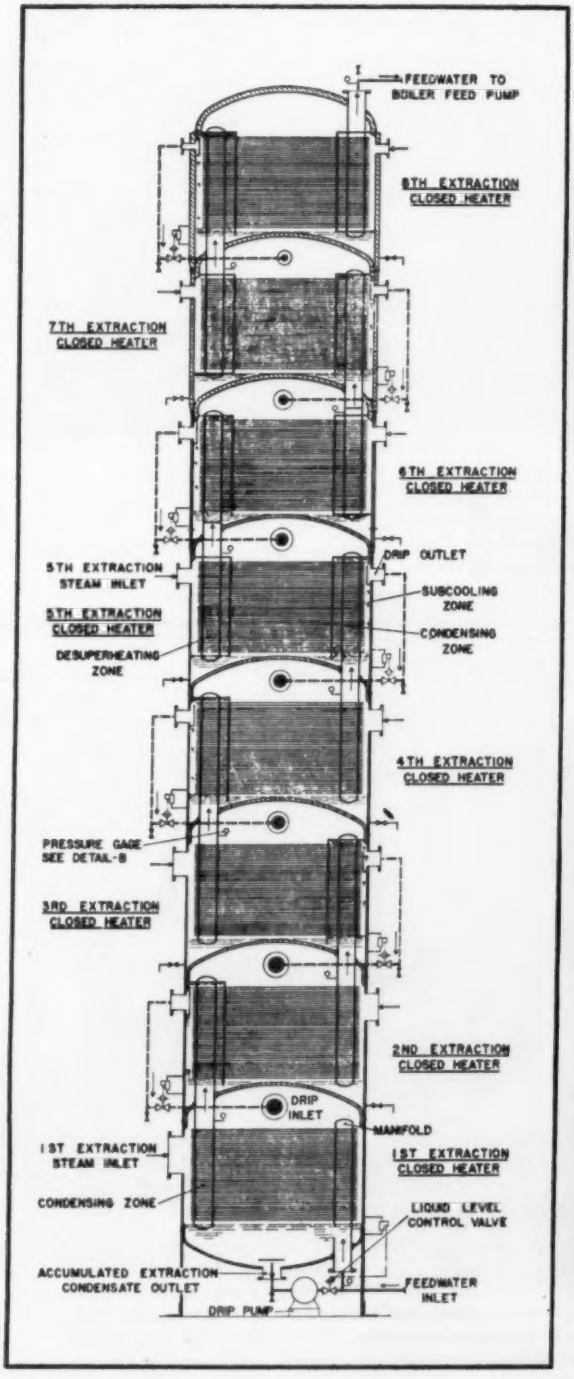


Fig. 1. (Left) Diagram of Type K feedwater heater assembly, employing closed heaters, for 150,000-kw, 2000 psig, 1050 F, 1000 F reheat. Diameter 10 ft; overall height 69 ft

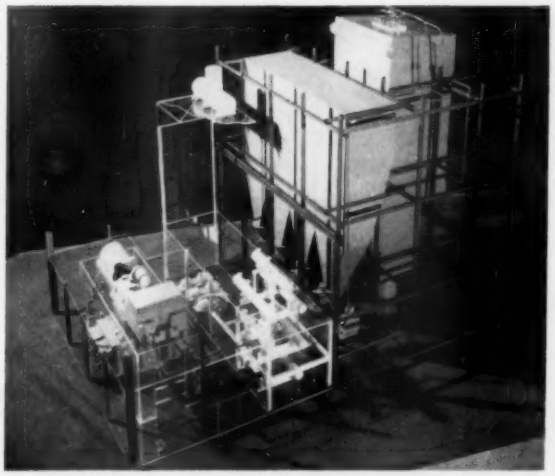


Fig. 2. Power plant model, showing conventional arrangement of typical 150,000-kw steam power plant, with 8 stages of feedwater heating located in the auxiliary bay

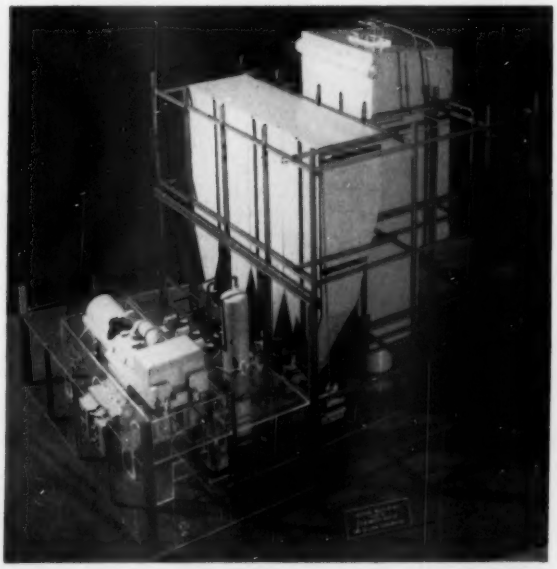
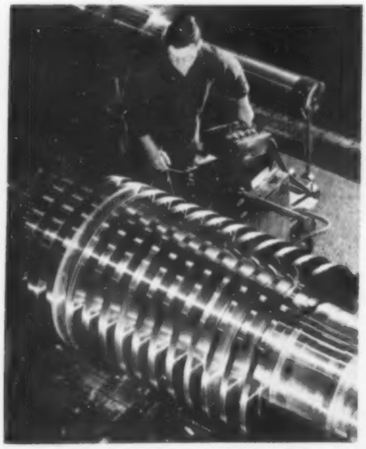
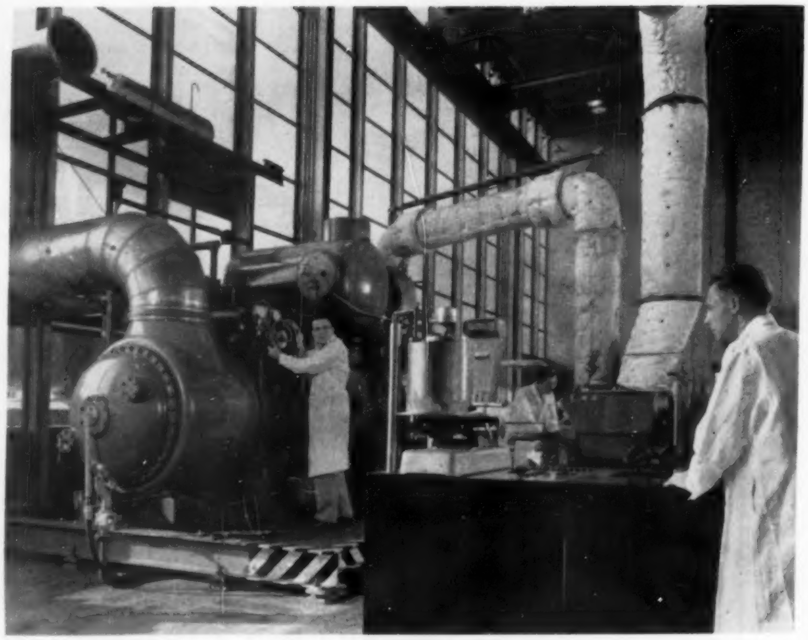


Fig. 3. Same model as Fig. 2, showing proposed arrangement of 150,000-kw steam power plant with vertical Type K feedwater heater in place of former feedwater heaters

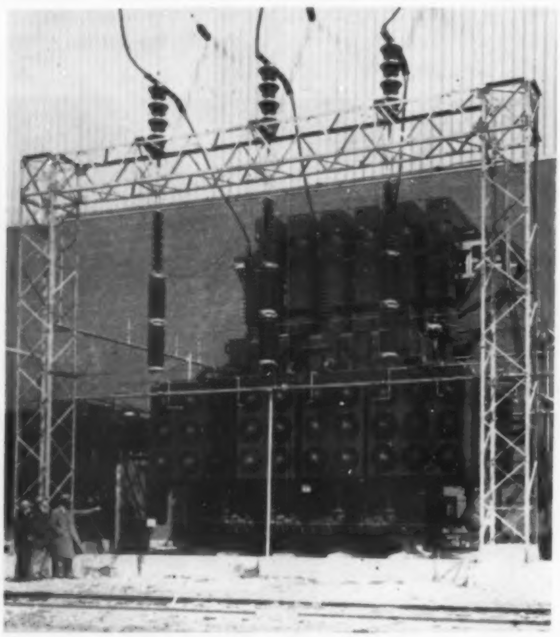


Powermaker for Spain is a 66,000-kw, 50-cycle steam turbine generator unit being made by GE for operation at Bilbao. Here is the 12½-ton high pressure element rotor of the turbine



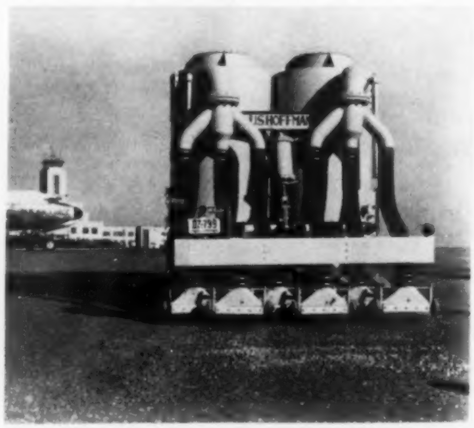
New family of engines (right) may grow out of this free piston gasifier, developed by General Motors for ship propulsion or power station. It combines diesel, air compressor, gas turbine

News Reel



Transformer, weight 448,000 lb installed, was shipped upright in a one-piece tank less bushings and cooling equipment, to Detroit Edison's new River Rouge plant. Made by Westinghouse, transformer is 315,000-kva, 17.3/129-kv

The World's Largest . . .

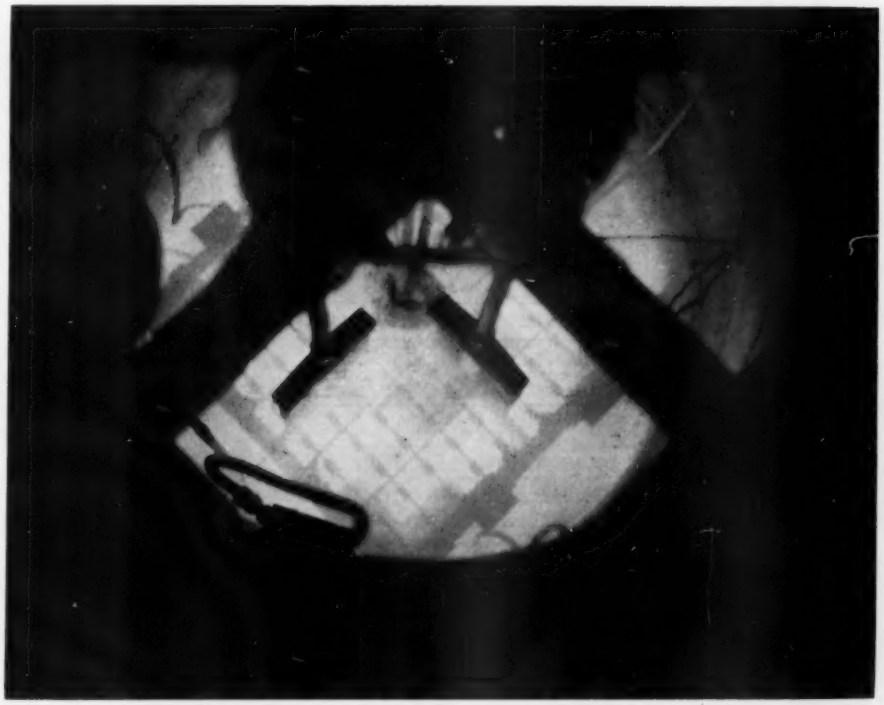


Vacuum cleaner known as the JARC (Jet Aircraft Runway Cleaner), is mounted in a truck body, looks like this from working end. The 8-ft cleaning swath sucks in materials at the rate of 350 mph

Shovel (right) rises 160 ft into the air (height of 16-story building), is owned by the Hanna Coal Co. of Adena, Ohio. With lifting power of 250 tons, the machine could lift a platform containing 166 1½-ton automobiles 100 ft into the air, swing them over length of football field,—all in 45 sec

Snake!—not in the grass, but in a motor. As mid-winter flood waters slowly subsided, Col. Fred Anderson of U. S. Army Corps of Engineers was astonished to see a 5-ft gopher snake leave his refuge in this motor housing

Turbines for the St. Lawrence hydro project at Barnhart Island, near Massena, N. Y., will use fabricated plate steel draft tube liners. Here's one ready to be knocked down for shipment from Allis-Chalmers' shops to the new hydro plant



Power rise from 2 to 510,000,000 watts in less than 1 sec was the phenomenon photographed in this remarkable view of the SPERT I Reactor, designed and operated by Phillips Petroleum for the Atomic Energy Commission. Camera looks down into water-filled tank of the reactor self-lighted by the radiation

UNIVERSITIES
COLLEGES
SCHOOLS
HOSPITALS
INSTITUTIONS

Will Your Boiler Plant Be

Every institution faces the same problem——how to keep its central heating capacity in step with building expansion. Here's a simple method of analyzing your system and forecasting future needs

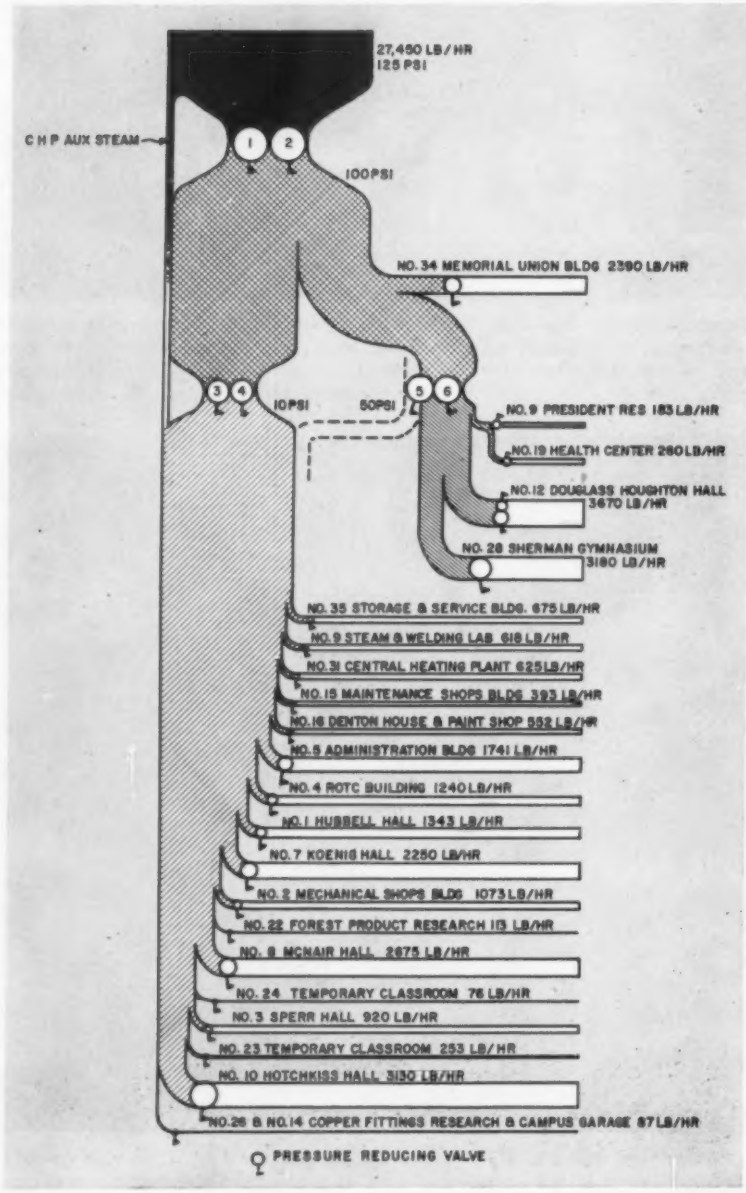

27,450 LB/HR
125 PSI
C H P AUX STEAM
1
2
100PSI
NO. 34 MEMORIAL UNION BLDG 2390 LB/HR
3
4
10PSI
50PSI
5
6
NO. 9 PRESIDENT RES 185 LB/HR
NO. 19 HEALTH CENTER 280 LB/HR
NO. 12 DOUGLASS HOUGHTON HALL 3670 LB/HR
NO. 28 SHERMAN GYMNASIUM 3180 LB/HR
NO. 35 STORAGE & SERVICE BLDG. 675 LB/HR
NO. 9 STEAM & WELDING LAB 618 LB/HR
NO. 31 CENTRAL HEATING PLANT 625 LB/HR
NO. 15 MAINTENANCE SHOPS BLDG 393 LB/HR
NO. 16 DENTON HOUSE & PAINT SHOP 552 LB/HR
NO. 5 ADMINISTRATION BLDG 1741 LB/HR
NO. 4 ROTC BUILDING 1240 LB/HR
NO. 1 HUBBELL HALL 1343 LB/HR
NO. 7 KOENIG HALL 2250 LB/HR
NO. 2 MECHANICAL SHOPS BLDG 1073 LB/HR
NO. 22 FOREST PRODUCT RESEARCH 113 LB/HR
NO. 8 MCNAIR HALL 2675 LB/HR
NO. 24 TEMPORARY CLASSROOM 76 LB/HR
NO. 3 SPERR HALL 920 LB/HR
NO. 23 TEMPORARY CLASSROOM 253 LB/HR
NO. 10 HOTCHKISS HALL 3130 LB/HR
NO. 26 & NO. 14 COPPER FITTINGS RESEARCH & CAMPUS GARAGE 87 LB/HR
PRESSURE REDUCING VALVE

Fig. 1. Flow diagram showing campus steam distribution at time study was made

By GORDON A. HELLMAN*

POPULATION FORECASTS indicate that there will be an ever-increasing demand on the physical plant capacity requirements of universities, colleges, schools, hospitals, and other public institutions. If your physical plant expansion program has new buildings due for occupation in 1960, it will be too late then to step up your central heating system to carry the extra load. To get an appropriation for more equipment, to engineer it, to order, install, and put it into operation takes years, not weeks, and you should be determining your future needs now.

Experience has shown that a heating system needs to be evaluated every four or five years so that plans can be made in time to keep pace with building expansion.

Here is a simple method used successfully at a mid-western college for analyzing its heating system and forecasting future requirements. The analysis was carried out under conditions likely to face an engineer in most other institutions; namely, equipment for testing and measuring was inadequate, it was not possible to interrupt service to take measurements, and available records for past years were limited.

Basically, the method consists of obtaining an average figure for pounds of steam per cu. ft. per degree day based on operations for past years, and then applying this figure to future buildings to forecast the maximum load they will require.

Here are the steps you should follow in analyzing your own system:

Step 1. List each building heated and obtain total cubage heated.

Step 2. From the nearest meteorological station or from the U. S. Weather Bureau Climatological Data Report for your state obtain figures for degree days for each year of the period you wish to analyze.

Step 3. From your plant records

* Asst. Professor and Central Heating Plant Engineer, Michigan College of Mining and Technology, Houghton, Michigan.

Large Enough in 1960?

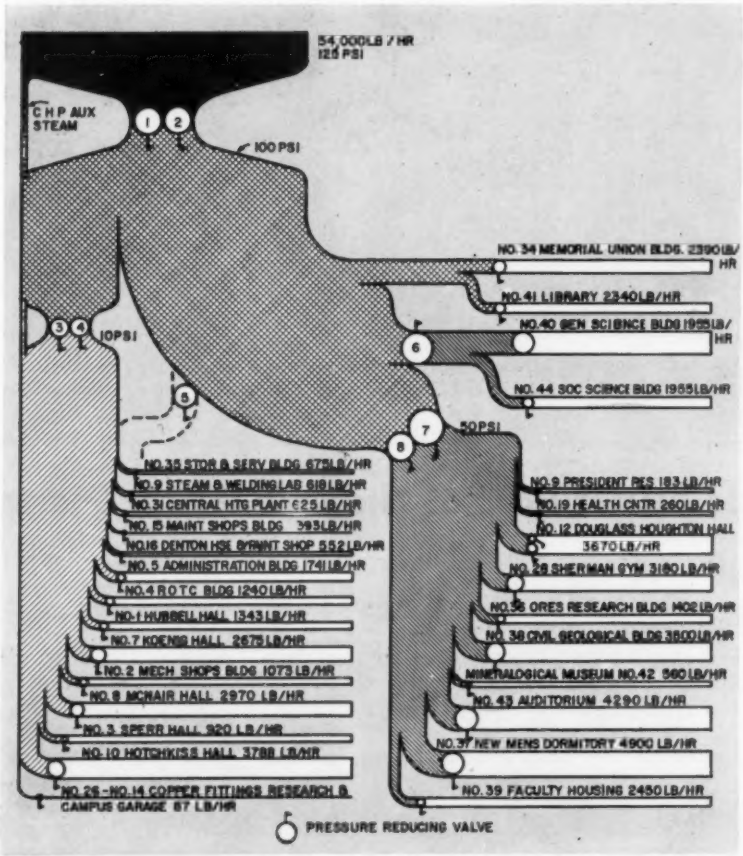

54,000LB / HR
125 PSI
CHP AUX STEAM
100 PSI
10PSI
50PSI
NO. 34 MEMORIAL UNION BLDG. 2390LB/HR
NO. 41 LIBRARY 2340LB/HR
NO. 40 GEN. SCIENCE BLDG 1955LB/HR
NO. 44 SOC SCIENCE BLDG 1955LB/HR
NO. 35 STOR & SERV BLDG 675LB/HR
NO. 9 STEAM & WELDING LAB 618LB/HR
NO. 31 CENTRAL HTG PLANT 625 LB/HR
NO. 15 MAINT SHOPS BLDG 393LB/HR
NO. 16 DENTON HSE & PAINT SHOP 552LB/HR
NO. 5 ADMINISTRATION BLDG 1741LB/HR
NO. 4 ROTC BLDG 1240LB/HR
NO. 1 HUBBELL HALL 1343 LB/HR
NO. 7 KOENIG HALL 2675 LB/HR
NO. 2 MECH SHOPS BLDG 1073 LB/HR
NO. 8 MCNAIR HALL 2970 LB/HR
NO. 3 SPERR HALL 920 LB/HR
NO. 10 HOTCHKISS HALL 3788 LB/HR
NO. 26 - NO. 14 COPPER FITTINGS RESEARCH & CAMPUS GARAGE 87 LB/HR
NO. 9 PRESIDENT RES 183 LB/HR
NO. 19 HEALTH CNTR 260LB/HR
NO. 12 DOUGLASS HOUGHTON HALL 3670 LB/HR
NO. 28 SHERMAN GYM 3180 LB/HR
NO. 38 ORES RESEARCH BLDG 1400LB/HR
NO. 38 CIVIL GEOLOGICAL BLDG 3800LB/HR
MINERALOGICAL MUSEUM NO. 42 960 LB/HR
NO. 43 AUDITORIUM 4290 LB/HR
NO. 37 NEW MENS DORMITORY 4900 LB/HR
NO. 39 FACULTY HOUSING 2450 LB/HR
PRESSURE REDUCING VALVE

Fig. 2. Flow diagram of campus distribution including proposed 1961–62 loads

obtain a figure for total lb. of steam produced per year by the heating plant for each year analyzed.

Step 4. Then for each year work out a factor F in lb. of steam per cu ft per degree day according to the formula

$$F = \frac{S}{D.D. \times C.F.}$$

Where S = lb. of steam produced per year
D.D. = degree days per year
C.F. = cubage heated in cu ft

Here as an example are values obtained by the Michigan College of Mining and Technology in a study which was made in 1954–55.

1951–52: Calculation of factor F.

$$F = \frac{97,681,200}{9434 \times 7,300,394} = 0.00142$$

1952–53: Calculation of factor F.

$$F = \frac{96,921,800}{9009 \times 8,015,194} = 0.00134$$

1953–54: Calculation of factor F.

$$F = \frac{96,408,200}{8587 \times 8,217,147} = 0.00135$$

An average factor of 0.00137 lb of steam per cu ft per deg day was used. This could also be expressed as pounds of steam per thousand cu ft per degree day.

As far as the accuracy of such a figure is concerned, it is of the same order as the factors used generally in estimating building construction costs on a cubic or square ft basis, and is therefore satisfactory for long range forecasting.

Step 5. The next operation is to evaluate the maximum load in lbs per hr for each unit of the distribution system. Before this can be done the average plant load factor has to be determined as follows:

$$\text{Plant Steam Load Factor} = \frac{S}{H \times ML}$$

Where S = lb of steam per year
H = 8760 hr per year
ML = Maximum steam load in lb per hr (obtained from heating plant records)

Typical figures of the Michigan College of Mining and Technology Plant Load Factor were:

1951–52

$$LF = \frac{97,681,200}{8760 \times 28000} = 0.398$$

1952-53

$$LF = \frac{96,921,800}{8760 \times 26500} = 0.417$$

1953–54

$$LF = \frac{96,408,200}{8760 \times 28000} = 0.393$$

A figure of 0.4 was used in predicting maximum load forecasts demanded by units of the distribution system.

Step 6. Now we also have enough information to estimate the maximum heating plant load for any future year. Procedure is as follows:

a. List all new construction and obtain a figure of cubic footage to be heated. This will be the sum of all present buildings plus all proposed construction expected to be in service by the year for which the forecast is required.

b. Apply the following formula:

$$ML = \frac{F \times CF \times DD}{H \times LF}$$

Where ML = maximum steam load in lb per hr.
F = factor in lb steam per cu ft per degree day
CF = total cubic footage
DD = degree days per year (use the figure corresponding to the year of most severe weather)
H = number of hours in a year — 8760
LF = plant steam load factor (obtained above)

The above factors and procedure could be applied to estimate the maximum demand of any unit heated by the central heating plant.

At the Michigan College of Mining and Technology this calculation showed that in 1961–62 the maximum load of the Central Heating Plant could be 61,000 lb per hr. This was based on proposed physical plant expansion and a maximum degree day year. Since the maximum capacity of each of the college's two boilers is 30,000 lb per hr, this meant that in 1961 both boilers would have to operate at a rate beyond their maximum guaranteed capacity. It was therefore apparent that a third boiler for standby was necessary and plans for one have been initiated.

The results of this analysis, in the form of steam flow diagrams, are

shown on page 79 in Figs. 1 and 2.

To project coal requirements as building cubage increased, the factor F for lb of steam per cu ft per degree day was used. Also a factor of evaporation of 10.5 lb steam per lb coal was taken as representative. This figure was obtained from records of steam produced and coal used.

On this basis projected coal requirements through the fiscal year 1961–62 were determined and plotted on the curve shown in Fig. 3. As an example, the projected coal usage for 1953–54 was 4,610 tons. Actual consumption was 4,712 tons. This is an error of approximately 2 per cent which is acceptable in estimating.

A subsequent article will deal with the problem of considering the installation of an extraction turbine generator as a replacement for a main header reducing valve in the central heating plant system.

This article is based in part on a thesis submitted in partial fulfillment of the requirements for the M.S. degree in Mechanical Engineering at Michigan College of Mining and Technology by the author and George F. Kruggel.

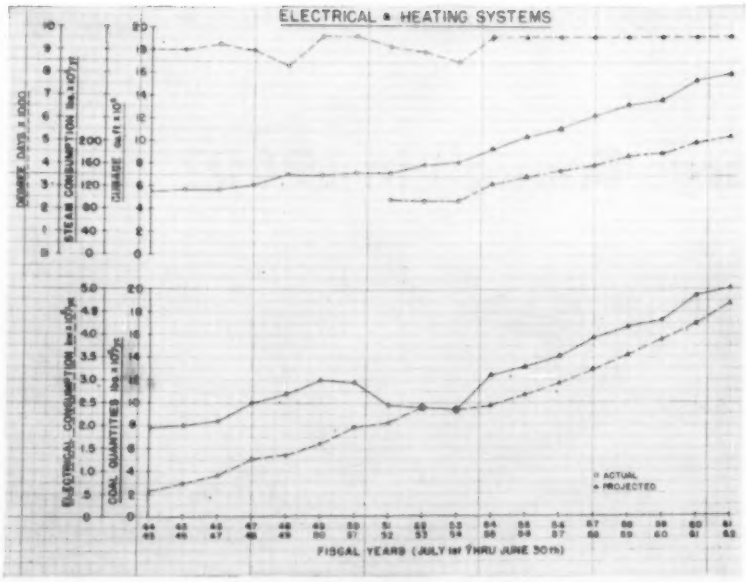

ELECTRICAL & HEATING SYSTEMS
DEGREE DAYS X 1000
STEAM CONSUMPTION lbs x 10⁶/yr
CUBAGE cu ft x 10⁸
ELECTRICAL CONSUMPTION kwh x 10⁶/yr
COAL QUANTITIES lbs x 10⁶/yr
• ACTUAL
▲ PROJECTED
FISCAL YEARS (JULY 1st THRU JUNE 30th)

Fig. 3. Curves giving actual and projected data for electrical and heating systems and coal requirements up to 1962 for Michigan College of Mining and Technology

Landslide Buries Part of Niagara Power Plant

ON JUNE 7, 1956, a huge mass of rock broke away from the face of the gorge on the American side of the Niagara River, about half a mile below Niagara Falls, and crushed a large portion of the Niagara Mohawk Power Corporation's Schoellkopf Station. More than 300,000 kw of generating capacity was destroyed and the damage has been estimated at several millions of dollars.

One man was reported missing, but sufficient warning was given to enable more than 40 workmen to escape to safety.

The photographs shown in Figs. 1, 2 and 3 are by courtesy of World Wide Photos.

Fig. 1. Schoellkopf Power Station before rockslide destroyed bracketed section

Fig. 2. After the landslide, with part of the station buried under tons of rock

Fig. 3. Another view of the ruined plant

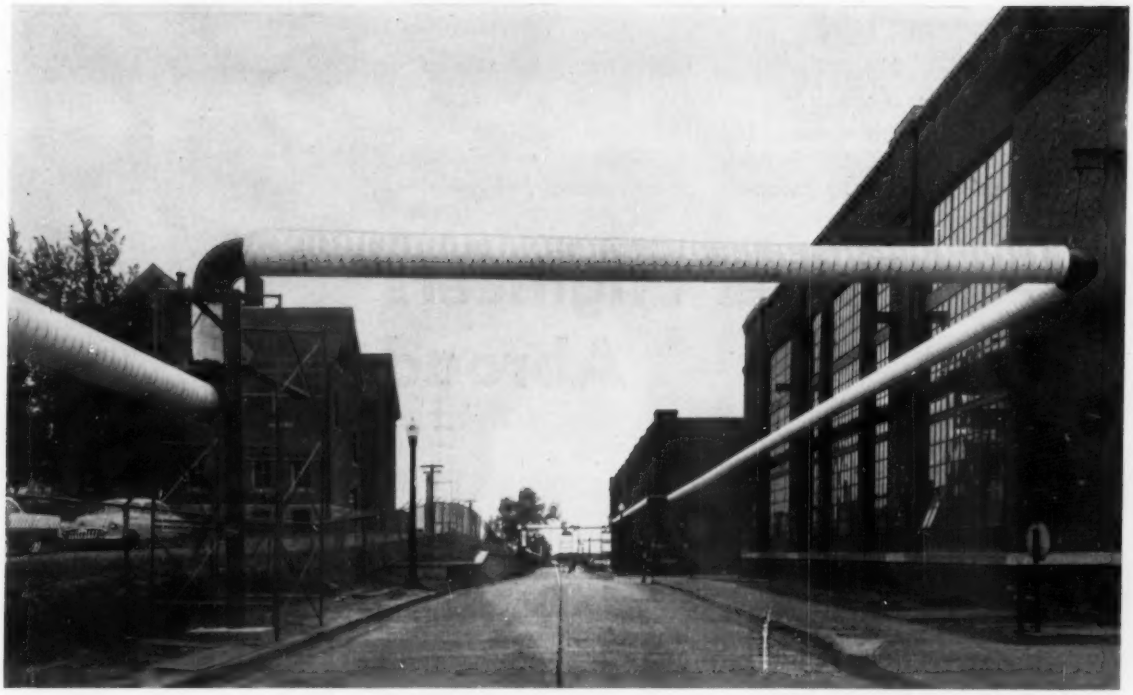


Fig. 1. Part of steam line from Delray to Jefferson Ave. Line is covered with 2 in. thickness of calcium silicate insulation

Detroit Edison Sells Surplus Steam

When surplus steam became available at their Delray power plant, Detroit Edison Company turned it to advantage by selling it to neighboring firms

AS A RESULT of Detroit Edison's expansion program, their Delray Power Plant found itself with additional steam generating capacity. About a year ago the company decided to produce and sell steam from Delray to neighboring companies for industrial processing, building heating, and other purposes. At present four customers are using this steam service and a fifth may be connected in the near future. The daily steam output is 2,500,000 lb.

Construction of the distribution system began in June 1955, and was completed in November of the same year.

The main line, built of 10 and 12 in. schedule 40 steel pipe, is capable of handling about 263,000 lb steam per hr. 1700 ft of the pipe is carried above ground on the Delray property and 6500 ft is laid from six to ten ft beneath two public thoroughfares.

All joints are welded for the piping system, and the pipe is covered with calcium silicate insulation to 2 in. thickness and then covered with a waterproof jacket secured by copper wires.

Because no condensate is returned to the plant, all the steam sent out must be replaced with make-up water. The amount of make-up water needed for the plant has increased from 700,000 lb per day to about 3,500,000 lb per day. A new demineralizer system has been installed to handle water purification requirements.

Steam for the new system is taken from two turbine leads in the low-pressure section of the plant, passed through a desuperheating station which reduces the temperature from 720 to 485F and delivered from the plant at a pressure of 400 psi. The system was designed to furnish steam to the last customer on the line at 125 psi.

Because the customers' pressure requirements vary from 165 to 50 psi, pressure-reducing valves have been incorporated with the metering equipment at each plant.

Steam is metered by orifice-type flow meters. Since these meters need to be used in a range of 20 to 100 per cent rated capacity, dual metering is used so that low rates of flow are measured by a low-capacity meter, while normal and heavy flows are measured by a higher capacity meter.

Fig. 2. Welding part of underground steam line. About 6500 ft of pipe runs underground, 1700 ft overhead. Pipe will handle 263,000 lb steam per hr

Air-borne Editors Morris and Kramer attend important international meetings in Europe this summer: 100th Anniversary of VDI in Germany; IPE in England; CIGRE in Paris; 5th World Power Conference in Vienna; also visit many European power plants and industries

Power Engineers Abroad

By RICHARD H. MORRIS

Editorial Director, POWER ENGINEERING

QUITE NATURALLY, we are frequently asked, "Why spend the summer in Europe when there is so much to cover in America?" The "we" consists of A. W. Kramer, Editor of POWER ENGINEERING, and myself representing both POWER ENGINEERING and *Plant Engineering*. To us the answers are quite obvious.

First: Our editors traveled a quarter of a million miles in North America last year. Even a three-fold increase in this travel would not materially change our article selection, whereas comparatively little travel outside established orbits opens up new possibilities.

Second: The importance of the Canadian and United States engineers' national and international activities calls for adequate representation at international engineering events.

Third: Rapid industrial recovery of West Germany and Italy, aggressive trade practices of Sweden and Switzerland, and expanding reciprocal trade agreements of the Soviet Union are already posing grave political, economic and industrial problems to the U. S. and Canada. American industrial magazine editors should be cognizant of these impending changes.

Wherever our investigations lead, we depend upon the maintenance crews of the airlines for our safety and peace of mind. Nowhere in industry has preventive maintenance been more highly developed. Nowhere is its effectiveness more appreciated by customer and management alike.

About 1950, the airlines boasted half a million trans-Atlantic passengers. Air travelers then were a snobbish lot. The occasional passenger who had not circumnavigated the globe at least once was low on the social scale. By comparison, the seafarer saltily initiated by Neptune at the equator was minor nobility. The camaraderie of the elite was unsurpassed.

Fig. 1. R. H. Morris, POWER ENGINEERING and *Plant Engineering*, addresses annual conference of the Incorporated Plant Engineers at Harrogate, England

Today millions fly the Atlantic each year. The elite, like nobility, have bowed to the proletariat and pass unnoticed in the rush. Mobs pass through the air field gates, as through subway turnstiles, and with as little regard for their neighbors.

So commonplace is this mode of travel that one can travel half way around the world still hesitating to interrupt his seat companion in the perusal of a newspaper. Newspapers one may pick up on the way may be in a dozen languages.

Yet, in the air crossroads of the world, few need be embarrassed by the ability to read only one language. Sign painters are sympathetic souls, cognizant of human needs in many languages. One may casually choose between "herren," "caballeros," "les hommes," "gentlemen," and so on. Only the Russians and Arabs have been overlooked in the parts of the world already visited. And in Germany, a note of caution — keep a 10-pfennigs piece handy.

In spite of these conveniences, one cannot avoid marveling at the speed of modern transport. Lunch in Chicago on Thursday; dinner with the Niagara-Frontier Plant Engineers' Club on the same day; lunch with members of the Glasgow Branch of the Incorporated Plant Engineers on Saturday; Wednesday in Hamburg; Thursday in Berlin and Monday in London.

Fig. 2. Small but picturesque dam and power house on one of the European rivers

Fig. 3. R. H. Morris, editorial director, at the convention headquarters of the German Engineers Society (Verein Deutsche Ingenieure) in Berlin, Germany, where the Society held 100th Anniversary international conference June 12–14

On the Bonnie Banks

In Glasgow, John Brown's shipyard on-the-Clyde has laid the keels of 700 ships since 1852, including the *Queen Mary* and the *Queen Elizabeth*. Here Rolls-Royce build their turboprop engines, which power the Capital and TCA Viscounts in America. In Edinburgh, the "castle" dates back to 1050; but carpets and beefsteak-and-kidney pie are modern.

Scotland is a land of lochs, bens, black face sheep, highland cattle, flowers, kilts, glens, inns and friends that can be left only with regrets and a strong conviction to return.

Hamburg Rebuilt

Hamburg, quite impartial between hamburgers and hot dogs, has been reasonably well rebuilt. Rivers and canals with water taxis and the traditional "free port" make it the Venice of the North.

Rebuilt Hamburg is a beautiful city. Foreigners cannot miss the "ostentatious ineffectiveness" in their appointments, the tolerance of Anglo-Saxons and the island shipyard which, rebuilt in 1950, has launched more than 50 large ships and now has Russian tankers on the ways.

From dinner with engineers in Niagara Falls on Thursday to dinner with plant engineers in Berlin on the next Thursday is not a common occurence. On May 12 I was in Berlin at the 100th Anniversary of the Verein Deutsche Ingenieure — The German Engineers' Society.

German Engineers

From an initial meeting of a few student engineers in 1856, this organization grew to a peak strength of 60,000 and an impressive *Ingenieurehaus* in Berlin in pre-Hitler days. The end of the war left the *Ingenieurehaus* in Russian hands, with all records destroyed. From a desk and a chair and one determined man, the organization has again grown to about 45,000, with headquarters in Dusseldorf.

From London my route circled, in more leisurely fashion, to the Ninth Annual Conference of the Incorporated Plant Engineers at Harrogate, then south in roundabout fashion through the industrial section of England and Wales to London.

Power Engineers Meet

London was the jumping off place for the International Conference of Large Electric Systems in Paris in the early part of June. This 10-day Conference, known internationally as CIGRE, was attended by a large delegation of Americans. It ran nearly to the start of the Fifth World Power Conference in Vienna.

These two conferences are of utmost importance to industrial and public utilities power engineers.

Following the World Power Conference, however, we planned a two-week tour through the industrial plants of Austria, Yugoslavia and Italy. The one week available for France and Switzerland was admittedly too fast but time was fixed by the Paris and Vienna Conferences and could not be changed.

From Vienna the trail will lead north and east, on a schedule not yet completed. The tour will involve a number of industrial magazine editors and will be under the auspices of the Society of Business Magazine Editors. This is an organization of publications, not individuals, and POWER ENGINEERING is a charter member.

G-E Reports on Failures at Portsmouth

GENERAL ELECTRIC engineers report that thorough examination of the two 100,000-kva, 330-kv transformers which failed at the Portsmouth (Ohio) area of the Atomic Energy Commission has confirmed that the primary source of the trouble did not involve the high-voltage windings.

The first failure occurred on Jan. 29, as a result of a misplaced strand of conductor in the low-voltage, 13.2-kv winding, which after seven months of service short circuited to an adjacent turn of the winding. The resulting current extended the fault until the differential relay removed the unit from service. There was no failure of the high-voltage winding.

The second failure occurred on March 11, due to the reactor associated with the load-tap-changing equipment. The insulation separating the reactor core legs and yoke failed, permitting circulating currents to be established in the reactor core, which produced arcing at the contact point. Carbon was generated from the oil and insulation, and gas bubbles were evolved. These bubbles accumulated in the main high-voltage insulation structure, ultimately resulting in sufficient reduction of insulation strength to cause breakdown.

The two units are being repaired and are scheduled for return in a month. The reactors in the six companion units will be replaced as a precautionary measure, without charge to AEC.

C L & P Engineers Study Atomic Energy

SOME 20 ENGINEERS at The Connecticut Light and Power Company have been going back to "night school" each week recently to study the Fundamentals of Nuclear and Reactor Physics. The course covers the basic science of atomic energy and the physics of reactor design and related subjects.

The idea of the 14-session course was originated by CL&P Vice President and Consulting Engineer Calvin T. Hughes. Getting qualified persons to teach the course presented no problem since three leading scientists were to be found at Yale University in New Haven. Dr. Ernest C. Pollard, chairman of the Department of Biophysics, Dr. Arthur R. Quinton and Dr. William J. Knox agreed to expose the CL&P class to as much background on atoms as each two-hour session would allow.

Dr. Pollard, who helped design and build Yale's first atom-smashing cyclotron in 1939, introduced the group to atoms, nuclei, radiations and energy. Dr. Knox discussed applications of nuclear physics.

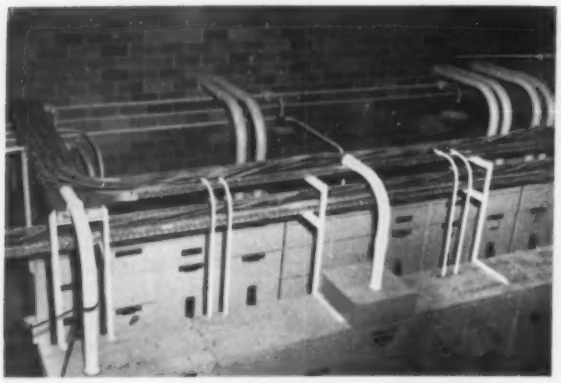


Fig. 1. Above. Power and control cables fed into switchgear on troughs are readily accessible for additions or changes

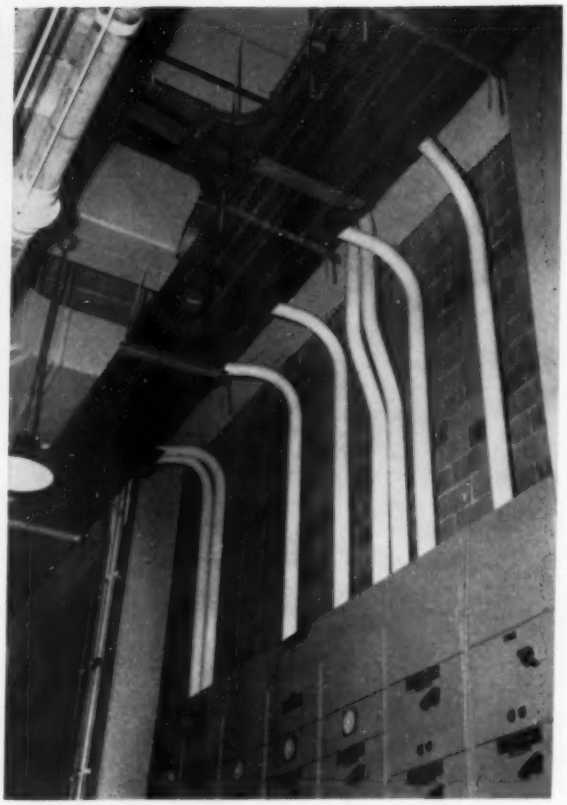


Fig. 2. Right. Trough installation above switchgear panel. Cables can also be brought out through bottom of trough

Cable Troughs Cut Wiring Costs

Author's firm has worked with cable troughs for more than ten years and others may be interested in this summary of their experience with troughs

By JOSEPH BECHER*

MANY ENGINEERS today are finding it possible to reduce wiring costs with a relatively new development — cable trough. Metal trough is economical, simple to design and install, saves space, and offers other advantages that for many installations make it the most suitable support for power and control cables. At Burns and Roe, Inc. we have worked with cable trough for more than ten years. It is possible that other engineering firms would be interested in a summary of our experience.

Evaluation of a new system is difficult unless there is some comparative basis by which it can be judged. Accordingly, we shall here use conduit as the standard. For some applications, conduit still remains the best system of support and we continue to use it in about 10 per cent of our work. Comparisons, therefore, are not intended to do more than clarify the advantages and disadvantages of cable trough. We use the expanded metal trough in preference to solid types because it is less costly, allows a higher cable rating, and it does not collect as much dust. We also prefer and specify the type of trough that has standard fittings for elbows, risers, drop-outs, etc.

The engineer who is designing a new distribution system will find that trough is easier to work with than conduit. With conduit, every connector, drop-out, new line, and the like must be designed in advance. Changes during installation are awkward and often costly. Trough installations are more flexible, for the trough can be cut and standard fittings inserted in straight runs to permit late alterations.

Original design, too, is simpler. We would estimate a saving of at least 10 per cent in the manhours required to design the system for an average generating station.

Trough simplifies the good use of space near walls and ceilings. During construction, a generating station in a very crowded place and access to several areas is generally harder to arrange than is access to one. Since trough saves a great amount of space, it is particularly applicable in this situation. Moreover, installation of cable is much faster and this minimizes confusion and crowded conditions.

In regard to space requiremnets, we would estimate a saving of about 50 per cent over conduit. The saving is even greater if more than two layers of cable are laid in the trays, but we don't recommend this practice unless current ratings are very low and overheating is not a problem. These savings are not fully realized when more than one run of trough is used, for working room must be left between trough levels.

Space becomes most important when cuts must be made through walls or floors and when approaching control panels. Here trough is of great value. This holds true in vertical as well as horizontal runs.

The advantages of trough over conduit will be immediately apparent to the engineer's client since a trough system is both easier to design and install than a conduit system, and resultant savings are quite evident.

Comparative costs can be broken into two parts: installation and material. Installation cost figures are determined almost exclusively by the time involved. Theoretically, a trough system could be installed in less than half the time required for conduit of equivalent capacity. Probably the savings in installing the cables are even greater, as cable is simply laid in place.

On an average, we would estimate a saving of about 25 per cent in installation costs — a substantial figure, since this is the largest part of the cost.

Materials savings are also significant. A 10-ft run of 24-in. trough weighs 520 lbs less than 10 ft of the equivalent capacity of 4-in. conduit. It is apparent that there is a saving

* Assistant Chief Electrical Engineer, Burns and Roe, Inc.

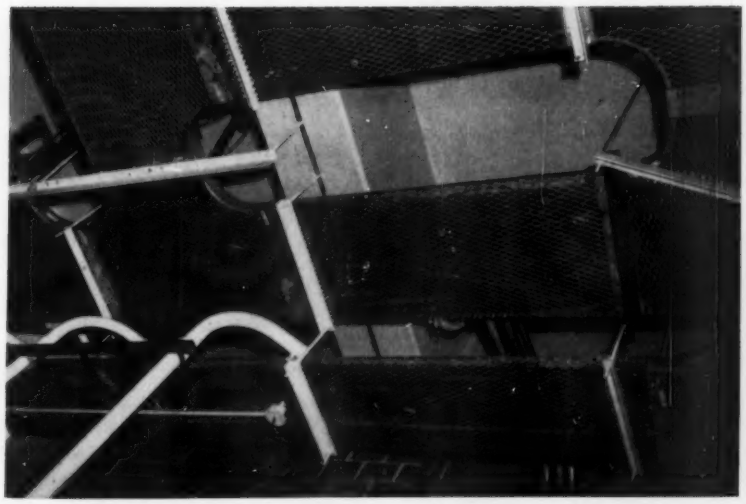


Fig. 3. Variety of trough fittings permit good flexibility even in crowded areas

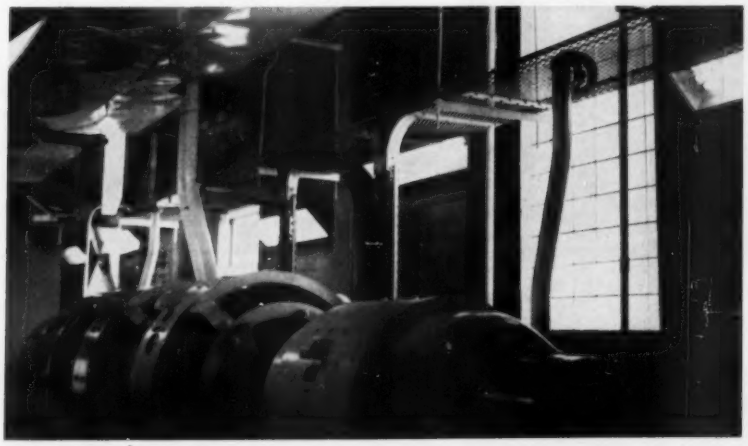


Fig. 4. Power cables to and from this motor generator set are carried by conduit and expanded metal cable through drop-outs passing through trough bottom

Fig. 5. Completely closed drop-out for heavy concentration of power cables

of more than a ton of steel in every 40 ft of cable support when using trough.

Electrical properties of cable in trough are superior to those of cable in conduit. We allow a free air rating if no more than two layers of cable are laid in expanded metal trough. The rating in conduit is approximately 0.65 if only 4 cables are used — even less if the number is greater. This means an increase of 20 per cent in current carrying capacity for the same cable. For similar current capacity, smaller cable is permissible in trough.

If the trough is considered a raceway instead of a support, the electrical properties of the trough itself must be considered. Tests seem to show conclusively that the trough is a sufficiently good conductor to activate the circuit protective devices on ground fault. It is conceivable that some trough connections might not be electrically tight, but we have not experienced any trouble in several hundred installations and have not had to require bonding across section joints. This would indicate that the electrical properties of each type of system are approximately equal.

One big advantage of trough for some installations is its adaptability to later modernization and expansion. There are few installations where one is certain that there never will be a new circuit needed or a change made in existing equipment requiring new cable! Addition of a new circuit, or even several new circuits, is a simple matter with trough as the new cable is added into existing trough. It is not good practice to pull new cable through conduit in excess of 40 per cent of the cross-sectional area. The alternative is to run more conduit and this is always costly even if possible. Major additions and alterations to existing systems are easier with trough for same reasons that apply to new installations.

We prefer the cleaner, more symmetrical appearance of trough to that of conduit, and have had no complaints from the dust collection standpoint.

The cables themselves are treated better in trough than in conduit since they generally are laid in place instead of being pulled. They are readily accessible for inspection, repair, rerouting, and replacement. There also is a higher salvage value to the cables in trough. It is true that trough will not localize trouble, but a major fire will damage the cables no matter where they're installed.

Trough, of course, cannot always be used; highly explosive atmospheres require completely protected systems. There are a few other special situations. However, cable trough is entirely suitable for utilities and for most industrial applications. Where it can be used safely, its advantages over conduit are considerable.

SAFETY AND TIME-SAVING IDEAS FOR TURBINE

"A" FRAME WITH HOIST . . . .

This is the sixteenth article in a series describing the scheduled overhaul of a 25,000 kw turbine generator at U. S. Steel Corp.'s South Works in Chicago. When all the articles have been published the whole series will be reprinted. To reserve copies of the reprint write to the Editor

IN THIS article we describe some of the ideas and methods used during the overhaul to save time and do the job safely. They apply to any turbine overhaul and may prove helpful to readers faced with similar problems.

Figures 1, 2 and 3 show views of a home-made "A" frame, mounted on wheels, large enough to straddle the turbine and generator, and carrying a 1½-ton hand operated hoist able to traverse the full turbine width.

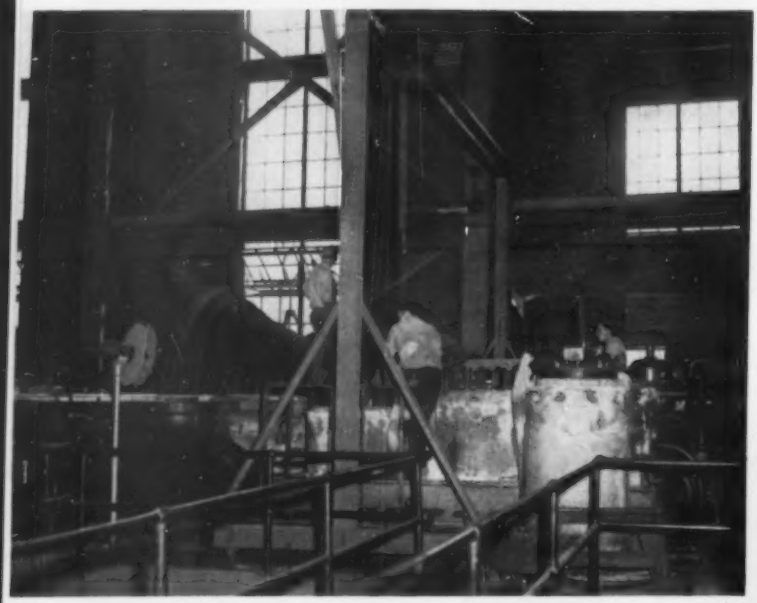


Fig. 1. Home-made "A" frame used during overhaul. Frame is mounted on wheels, straddles turbine and generator, and carries a 1½ ton hoist

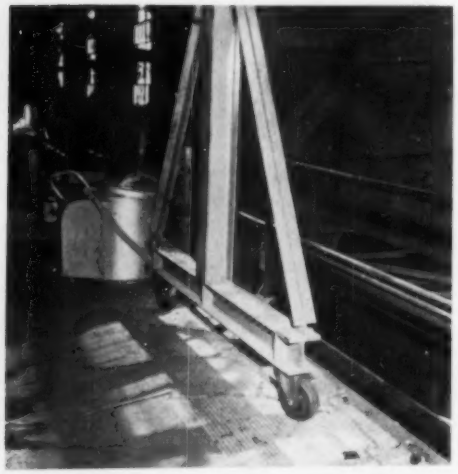


Fig. 2. Base of one side of "A" frame

This "A" frame proved invaluable during the overhaul. It saved tying up the large crane for small lifts, and it was ideal for the kind of job shown in Fig. 3, where the large crane is immobilized holding the generator rotor, while work is in progress on a bearing housing. It also saved a great deal of time and effort in small lifts around the job — lifts that were not heavy enough to justify use of the large crane, but heavy enough to be awkward and slow without a hoist.

Fig. 3. Left: "A" frame hoist being used for cleaning and preparing bearing housing while large crane is immobilized holding weight of generator shaft

TWO MEN IN CRANE FOR IMPORTANT LIFTS

FOR heavy and difficult lifts, where a false move could cause very expensive damage, the crane operator always had a helper in the cab in case he was taken ill or lost control for any reason. Figure 4 shows the operator and helper together during an important lift.

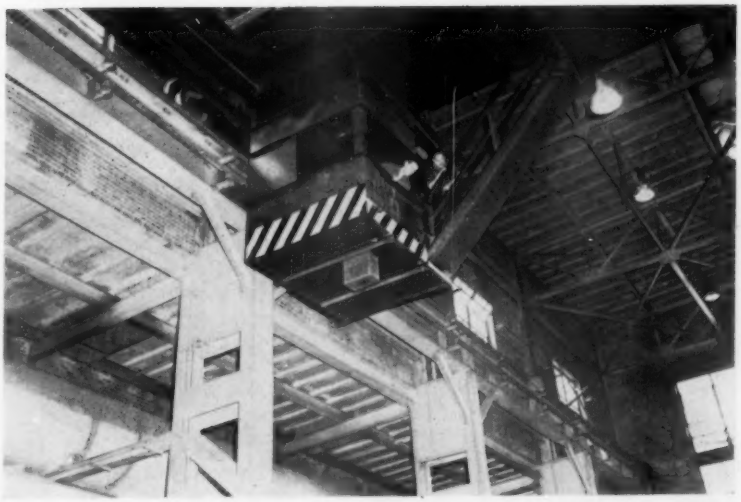


Fig. 4. Two men in crane control cab while the generator rotor was removed

MARKING LAGGING COVERS BEFORE SHUTDOWN . . . .

THIS IS the kind of small precaution that can save a great deal of time at a later stage of the overhaul. The sections of sheet steel forming covers over the h-p cylinder lagging were very similar in shape, and when being reassembled, a lot of time could be wasted finding the right place for each piece. By marking the angle iron supports and the adjacent cover with corresponding numbers, as shown in Fig. 6, the covers were replaced without difficulty.

Fig. 5. Removing lagging covers from h-p end of turbine. Markings (Fig. 6) enable covers to be replaced quickly

Fig. 6. Left: Cover sections and framework were marked with corresponding numbers so the covers could be replaced without confusion at end of overhaul

WELDED TROUGH FOR SANDBLASTING

TO PREVENT fine abrasive and water being sprayed all over the shop, and to form a sump from which the water-abrasive mixture could be collected and re-pumped for cleaning, a sheet metal trough was built round the part of the spindle that needed sandblasting. Figure 7 shows welding in progress on the trough.

Fig. 7. Welding temporary sheet steel trough to hold water-abrasive mixture used for sandblasting turbine blading

ALIGNMENT MARKS ON CRANE RAILS . . . .

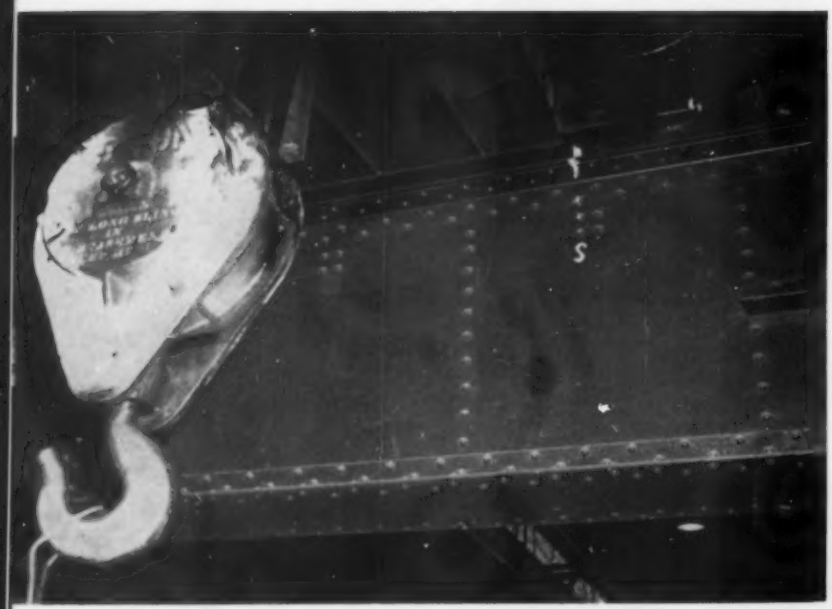


Fig. 8. Above: When white marks on crane rail and trolley coincide as shown the crane hook is exactly over the longitudinal axis of the turbine and generator

WHEN EITHER the turbine cover or spindle was being lifted, it was essential for the crane hook to be located immediately above the center of gravity of the load to avoid any side swing. A lot of time can be spent adjusting the position of the crane every time a lift is required. During the last overhaul of this unit at U. S. Steel, when they had the crane in the correct position for lifting the turbine cover, they marked the crane's position on the rails with a dab of white paint, as shown in Figs. 8 and 9.

Now, whenever they want to lift the turbine cover, they place the crane so that the marks on the crane and the rails coincide and no time is wasted adjusting the position of the crane. The correct position of the trolley is also marked the same way.

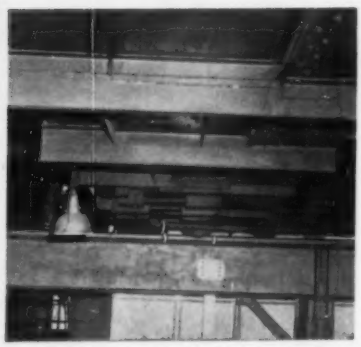
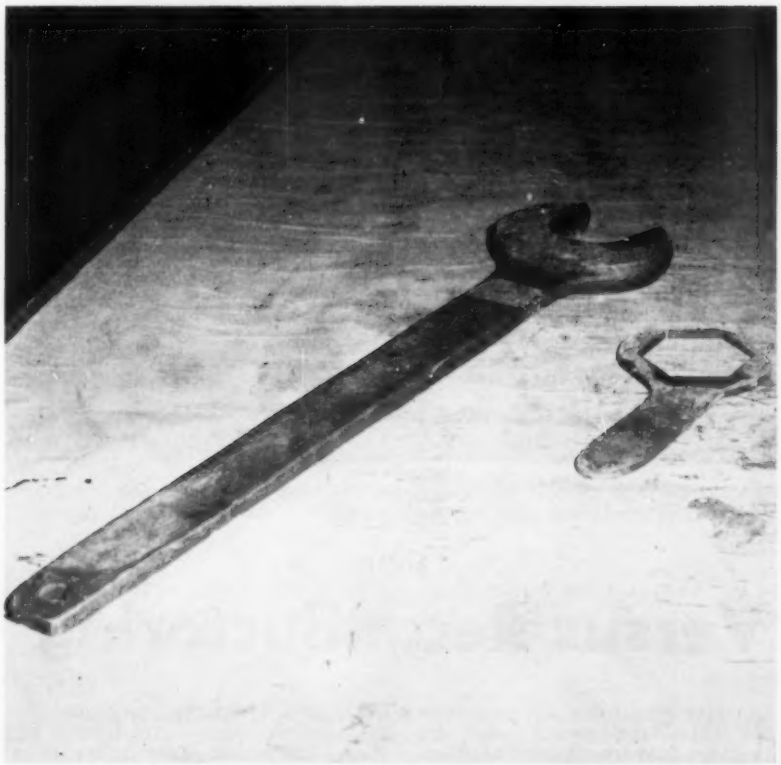


Fig. 9. Right: Two marks are made on the main crane rails. One gives the correct hook position for lifting turbine cover, the other for lifting the turbine rotor

LIGHT-WEIGHT WRENCH



THE H-P STUDS were 3 in. dia, and the wrench for loosening them was long and heavy. After the nuts had been loosened with the large wrench some were still just a little too tight to be run off by hand. Using the large heavy wrench meant a lot of hard and unnecessary work, so to remove the stud nuts which were too tight to be turned by hand, a small light sheet metal wrench was made, and much time and energy were saved. Both wrenches are shown in Fig. 10.

Fig. 10. Left: Shows contrast between heavy normal wrench and light home-made wrench for removing large stud

Next month's article will be the last one in this turbine overhaul series. When it has been published the whole series will be reprinted. If you want one or more copies of the reprint write to the Editor, POWER ENGINEERING, 110 S. Dearborn St., Chicago 3, Ill.

Here are the titles of the articles making up the reprint: — Planning . . . preparation . . . preliminary work; Removing turbine cover and spindle; Turning turbine cover; Reblading; Metallizing turbine shaft; Machining turbine spindle; Electrical inspection and testing; Pulling generator rotor — Parts I and II; Adjusting bearing pads; Balancing; Overhauling auxiliary equipment — Parts I and II; Safety and time-saving ideas — Parts I and II.

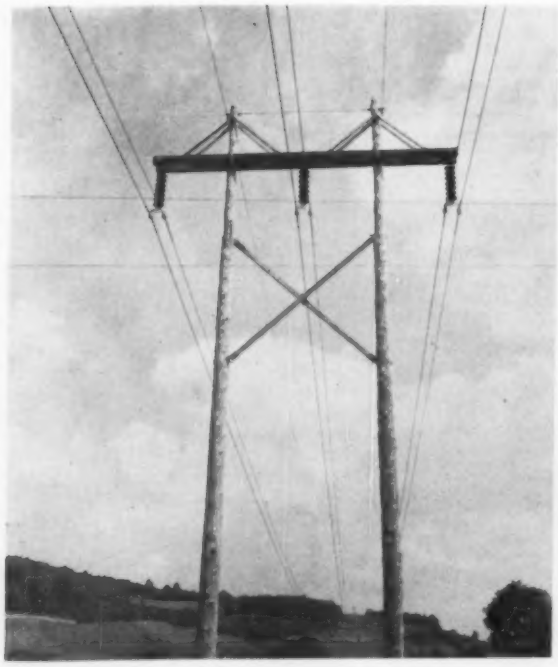


Fig. 1. Pennsylvania Electric Power Co.'s 115 kv line after bundling. Each line consists of two 266,800 CM conductors

Fig. 2. Installing spacers by hand in the field using a cherry tree pole lashed to a boom and the blade on a bulldozer

Bundling Versus Reconductoring

WHEN a 25-mile section of one of the Pennsylvania Electric Company's 115 kv power lines required its capacity to be increased, economic analysis favored bundling instead of reconductoring.

The line comprised about 200 two-pole wood H-frame structures carrying 266,800 6/7CMACSR conductors at 12 ft spacing on 25 ft cross arms. Bundling consisted of adding another 266,800CM conductor to each line to give a final arrangement as shown in Fig. 1. Reconductoring would have meant removing the existing conductors and replacing them with 636,000CM conductors.

It was estimated that the savings effected by bundling over reconductoring amounted to $45,000. Table II gives a breakdown of costs for the bundling operation, and Table I gives a comparison of electrical characteristics between the bundled line and various sizes of single conductors of the same tyye.

Several methods of bundling were studied in order to find the best one for this particular line. Vertical spacing was ruled out as it would reduce

Table 1. Electrical characteristics for various sizes of ASCR single conductors compared with those of bundled conductors

	Copper Equivalent	Approximate Current Carrying Capacity	Inductive Spacing Factor	R/Mile	X_L/Mile	Total R + J X	Total Z	Cap. Spacing Factor	X_C/Mile
Single Conductor 266,800 ACSR	3/0 167,800 CM	460 100%	0.3295	0.352 100%	0.7955 100%	8.97 + 20.27	22.2 100%	0.0805	0.1884 100%
Single Conductor 500,000 ACSR	314,500	690 150%	0.3295	0.187 53%	0.7505 94.4%	4.77 + 19.12	19.7 88.6%	0.0805	0.1778 94.3%
Single Conductor 556,500 ACSR	350,000	730 159%	0.3295	0.168 47.7%	0.7495 94.1%	4.28 + 19.10	19.6 88.3%	0.0805	0.1770 94.0%
Single Conductor 636,000 ACSR	400,000	770 167%	0.3295	0.148 42%	0.7435 93.5%	3.78 + 18.95	19.3 87%	0.0805	0.1755 93.1%
Bundled Conductor 266,800 ACSR		920 200%	0.3295	0.176 50%	0.5570 70.0%	4.49 + 14.19	14.9 67%	0.0805	0.1330 70.5%

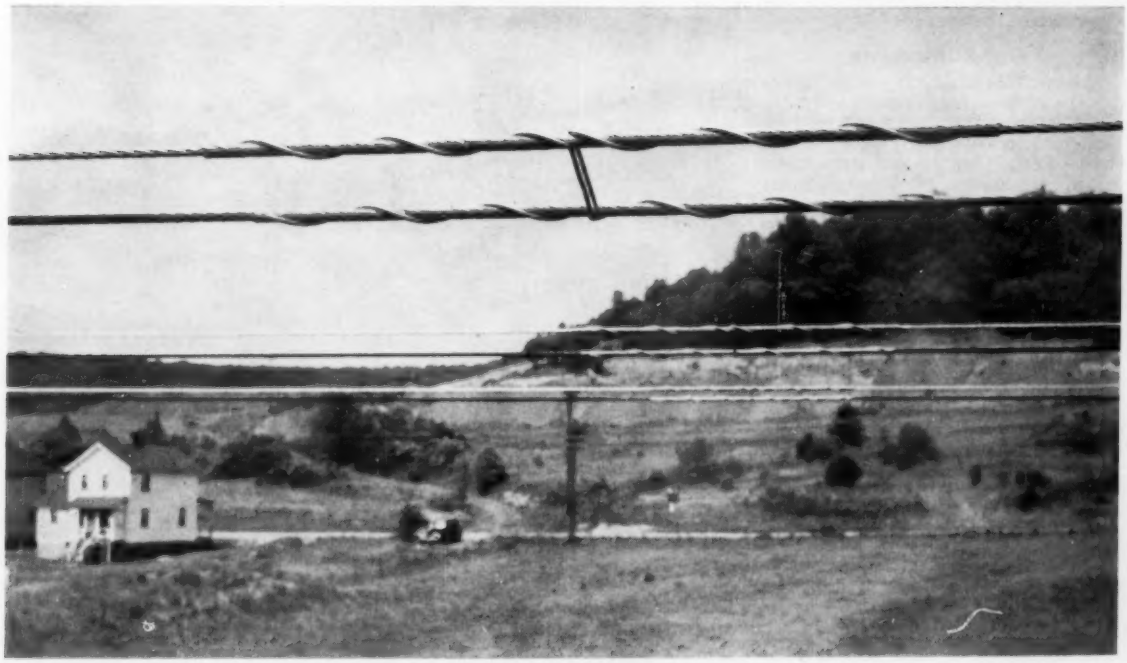


Fig. 3. Preformed spacers installed on bundled line to prevent conductor contact. Spacers were installed at maximum spacing of 200 ft. Fig. 2 shows installation

Capacity of an overloaded power line can be increased by reconductoring or by bundling, i.e. adding new conductors to an existing line. Here are details of a recent 115 kv bundling operation

ground clearances and give danger of conductor contacts under unequal ice loadings. Also, under unequal ice loadings in adjacent spans, extraordinary stresses would be imposed on a stiff linkage due to unbalanced longitudinal line tensions.

It was finally decided to use one half of a standard commercial strain yoke (an Ohio Brass 79631 medium duty strain yoke). A standard socket clevis was used between the top of the yoke and the insulator string. Special clevis eye linkages were used between the bottom of the yoke and the conductor suspension clamps.

These were designed with a long clevis end so the sub-assembly would hang in a vertical plane even when the insulator string would swing in high winds. Calculations showed that existing 15,000 lb insulator strings would be adequate on all structures except dead end structures under all phases of loading including ¼ in. radial ice.

Spacers

It became clear in the early stages of design that conductor spacers would be necessary, and this was confirmed by the installation of a test span. Rigid spacers were rejected since conductor movements could damage both spacers and conductors.

It was finally decided to use preformed line spacers of the type shown in Fig. 3. Spacers are installed equidistant in each span at a maximum spacing of 200 ft. The spans that were bundled varied from 200 ft to 1285 ft. A maximum spacing of 200 ft was necessary to eliminate conductor contacts.

The spacers were installed by means of a rig developed in the field, consisting of a pole cut from a wild cherry tree lashed to a boom and winch line and to the blade at the bottom of a bulldozer, as shown in Fig. 2. Steps were installed on the pole so that a lineman could climb to the top of the pole and install the spacers by hand.

The rig moved as a unit but the pole was generally lowered and lashed to the side of the bulldozer when moving between spacer positions on hillside spans. It was possible in nearly every case to install the spacers from the top of the pole without the necessity of lowering the conductor.

Investigation showed that the line in its entirety had been loaded to tensions which varied from 1800 to 5700 lb. Accordingly, the new conductor was pre-stressed to the same tensions before stringing.

Both old and new conductors were placed in blocks in order to allow the old conductor to equalize tensions in adjoining spans. Sagging the new conductor then resolved itself into the simple procedure of matching the sags in the old conductor by means of a transit.

Some trouble was experienced after the new wire was clipped in when it began to droop below the old one. It was necessary to resag a portion of the new line to correct this trouble. The new wire continued to droop, however, so that some spacers were cocked as much as 45 deg.

Effect of Oxidizing

As the old conductor was practically black through oxidizing, it was at first suspected that differences in conductor temperatures might account for the differences in sags. A rough temperature check revealed, however, that only a difference of 3 to 7 deg existed even in bright sunlight.

It is planned to allow the conductor to hang for a year or two and then take what steps are necessary to

---

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equalize the sags to improve the appearance of the line.

Angle Structures

At medium and heavy angle structures a support for the new conductor was devised that consisted of the following: a Hubbard primary clevis was attached to the old suspension clamp by means of a longer heat treated bolt, an Ohio Brass combination ball eye and shackle, an Ohio Brass socket eye, and finally another suspension clamp for the new conductor. This assembly gave a 13⅝ in. conductor spacing and allowed the conductors to hang in approximately a horizontal plane.

Figure 4 shows an angle structure, with the inset photograph illustrating the conductor support assembly. Some additional guying was necessary to sustain transverse loading at angle structures, and it was also necessary to remove two sets of arcing horns from wood guy insulators at one pole to provide adequate conductor clearances.

Suspension structures were modified only to the extent of changing some arm braces where long vertical spans overstressed the arm assemblies due to heavy vertical loading. The existing arm assemblies were rated at 6880 lb ultimate and the new assemblies at 10,000 lb.

The information in this article is based on an AIEE paper by P. L. Lumnitzer and M. J. Fulton of the Pennsylvania Electric Company, presented at the Winter General Meeting of the AIEE in New York in February 1955.

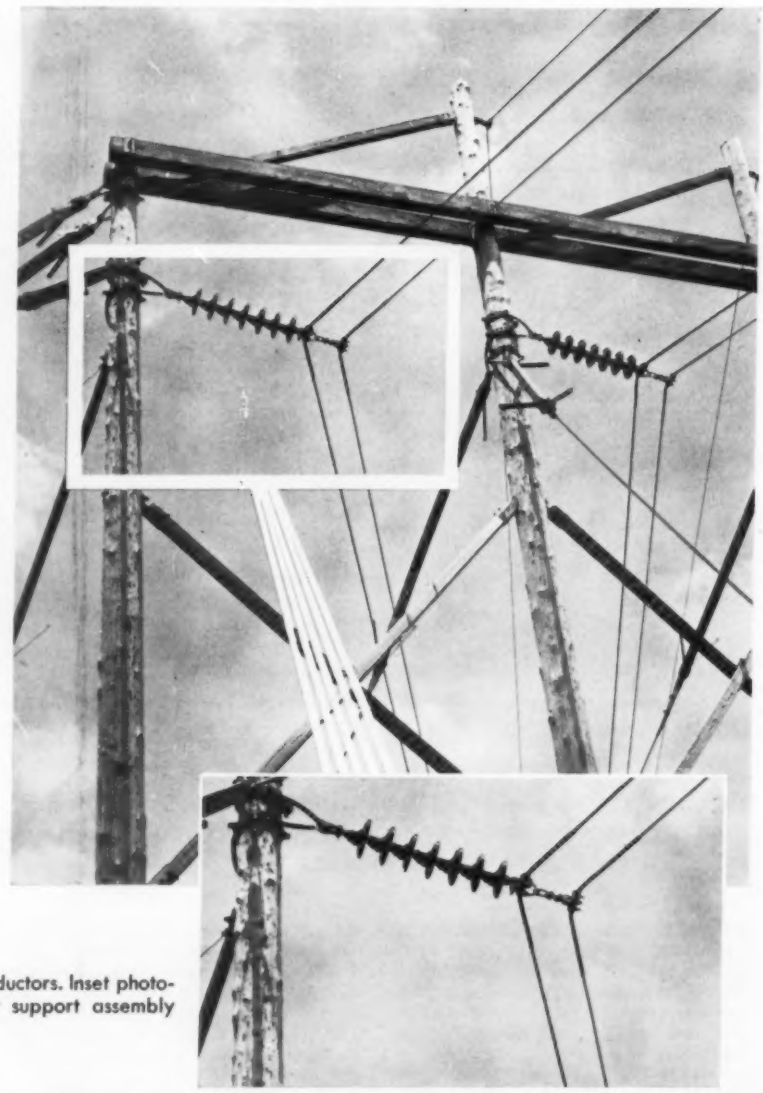
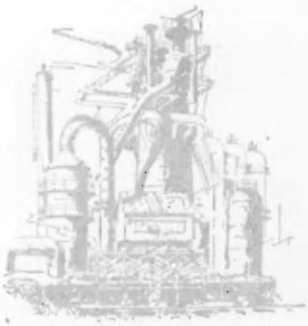


Fig. 4. Angle structure with bundled conductors. Inset photograph shows details of new conductor support assembly

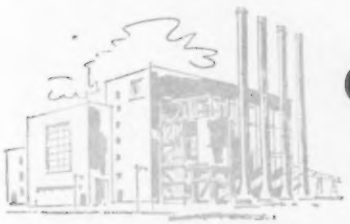
Table 2. Cost of labor and materials for this bundling operation. Bundling gave $45,000 saving over reconductoring

Material			Labor	
353536′	266,800 ACSR 6/7 Conductor	$33,454	Install Anchors & Guys	1,440
51747′	636,000 ACSR 24/7 Conductor	11,180	Changing Arm Braces	896
			Install Double Arms	2,390
1550	Sets of Armor Rod Spacers	6,355	Remove Bells & Drop Guys	120
530	Strain Yoke Plates	1,550	Final Clean Up	470
1100	Clevis Eye Connectors	1,410	Cut out Sleeves in Old Wire	64
450	10″ x 5¾″ Suspension Insulators	1,224	Unload Reels	233
10	Guard Poles (Net)	814	Deliver and Return Reels	1,620
98	Sets of No. 2016 Crossarm Braces	680	Clearance Poles	14,900
550	Socket Clevises	358	String New Wire	10,500
21	Strain Clamps	307	Sag New Wire	12,900
597	Sets of Armor Rods	1,400	Clipping In	7,500
450	Suspension Clamps	1,112	Bundling	10,500
	Miscellaneous Material	1,372	Jumper Loops	1,865
		61,216		65,398

Total Labor plus 15% Overheads	77,200	Miscellaneous Costs	6,145
Supervision and Engineering	1,639	Interest	1,777
Total Labor and Material Cost	$147,977		

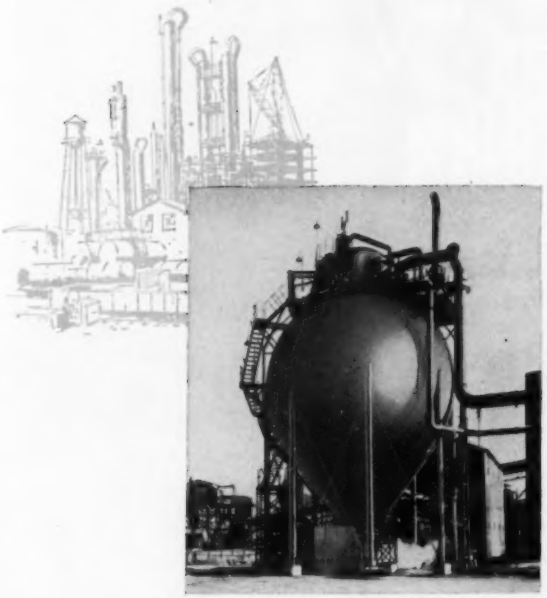


First in water conditioning



Cochrane HOT PROCESS

AT U.S. STEEL'S CLAIRTON PLANT



Designed to soften and deaerate 100,000 GPH of boiler feed water, this Cochrane unit at U.S. Steel's plant is a sludge blanket design deaerating type Hot Process Softener with a 38' dia. spherical top sedimentation tank. The Softener is followed by six 11' dia. anthracite filters equipped with surface washers.

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Power Engineering handbook

Try Using a Tailstock Chuck Adaptor

BY F. E. RILEY

THE ORDINARY engine lathe has sometimes been called "the king of tools," and there is no doubt that the versatility of the work which can be done on a lathe justifies this somewhat extravagant title. In the distant past, the lathe was the principal machine tool in the average engineering shop and it was expected to perform the majority of machining operations that were likely to be encountered. Because of the intensive development of other machine tools, the basic versatility of the lathe is apt to be forgotten.

But even the most rudimentary of maintenance shops is equipped with a lathe, and the power engineer who feels that his small shop is incapable of doing certain jobs, should first consider how he can make a replacement part on the lathe, before he farms out the work to some jobbing shop that may keep him waiting and some part of his plant standing idle.

A lathe attachment that will greatly enlarge the range of work that can be tackled on the average engine lathe is the tailstock chuck adaptor. In its simplest form, the adaptor comprises a Morse taper shank at one end for engagement with the taper hole in the lathe tailstock barrel, and carries at its other end a thread and locating shoulder which is an exact duplicate of the lathe spindle nose. The attachment allows any chuck or face plate normally mounted on the spindle nose to be mounted on the tailstock. This opens up various interesting possibilities for doing unusual jobs on the lathe.

Shaping Keyways

One of the most useful functions of the tailstock chuck adaptor is in the shaping of internal and external keyways in parts which have been turned. Fig. 1 shows a general view of a small lathe set up for shaping an internal keyway in a bushing mounted in a chuck on the tailstock. The bushing was bored in the three-jaw chuck shown while mounted on the spindle nose at the left of the picture. After turning was completed, the chuck, together with the bush gripped in its jaws, was unscrewed from the spindle nose and transferred to the thread on the tailstock chuck adaptor. In this way, the bore of the bushing is still aligned perfectly with the main center line of the lathe.

It was common practice in the old days for the lathe operator to shape all internal and external keyways with the work held in the headstock chuck before finally removing the job from the machine. The procedure was to grind a slotting tool to the width of keyway required and to mount this tool in the end of a stiff boring bar, usually with the center line of the tool bit placed horizontally, as shown in Fig. 2. A succession of shaping cuts could be taken through the bore of the work by cranking the lathe saddle along the bed by hand with the lathe spindle locked against rotation. An increment of cut for the slotting tool was provided by adjustment of the lathe cross slide before each pass of the tool through the work.

On cast iron, the labor involved in shaping out a keyway by hand cranking of the lathe saddle was not excessive, but the work of cutting a keyway in a piece of tough steel was very heavy, particularly if the keyway was long. The tailstock chuck adaptor allows keyways

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fold along this line—outside edges toward you

Fig. 1. Small lathe set up for shaping an internal keyway in a bushing mounted in chuck on tailstock

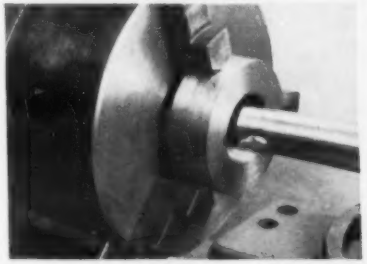


Fig. 2. Old way was to grind slotting tool to width of keyway required and mount in end of boring bar, with center line of tool bit placed horizontally

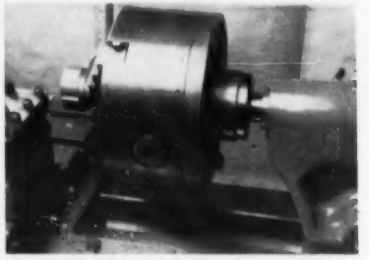
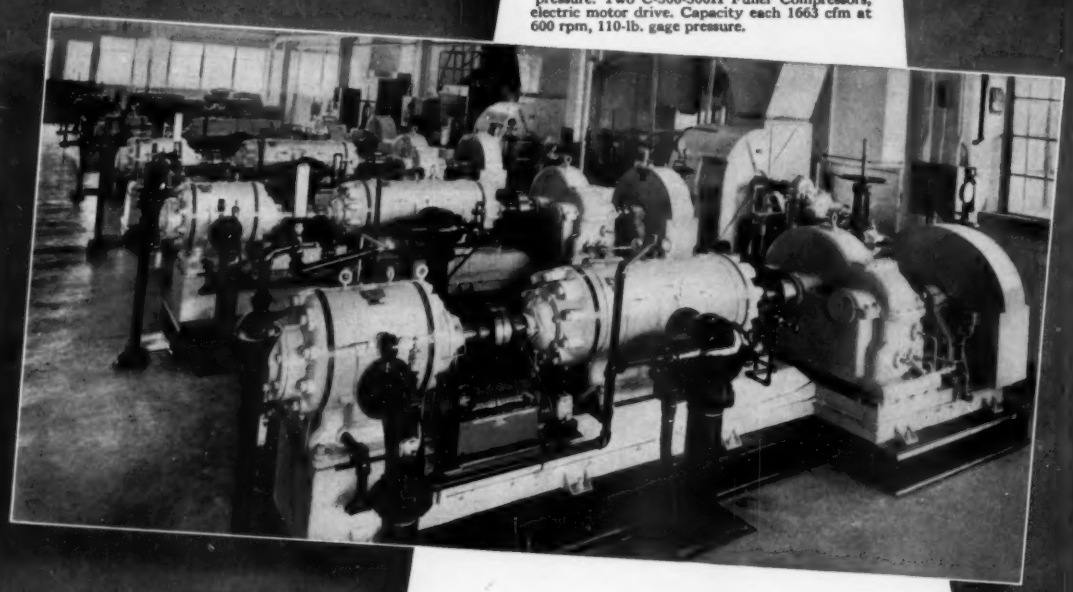


Fig. 3. With tailstock chuck adaptor, short-length external keyways or slots can be power-shaped very easily, avoiding the effort of hand cranking

cut along this line

Four C-300-300H Fuller Compressors, steam turbine drive. Capacity each 1248 to 1805 cfm with a corresponding speed range of 450 to 650 rpm; one 125 and three 110-lb. gage pressure. Two C-300-300H Fuller Compressors, electric motor drive. Capacity each 1663 cfm at 600 rpm, 110-lb. gage pressure.



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Aircraft companies use a lot of compressed air in the manufacture of airframes, engines, systems and components. The battery of six Fuller compressors pictured above meets one important aircraft facility's entire diversity of compressed air needs, efficiently and economically.

The key to Fuller's smoother operation is *rotary motion*, which provides large capacity in relation to size, simple direct drive from motor or internal combustion engine, minimum number of working parts, one-way air flow free from pulsation, lack of vibration, continuous service with minimum supervision and maintenance. Operation in cramped quarters or on ordinary flooring is simple and practicable.

Fuller Rotary Compressors are built for capacities to 3300 c.f.m., 125-lb. pressure. Write for Bulletin C-5A, illustrating and describing these machines.

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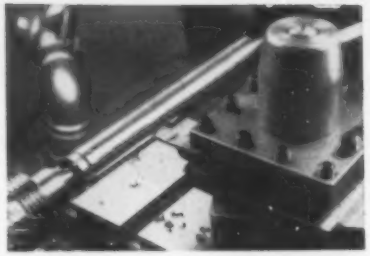


Fig. 4. Blind-ended keyways of any length in long and slender shafts can be power-shaped economically

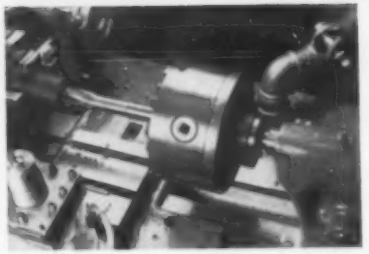


Fig. 5. Showing value of tailstock chuck in gripping straight shank of large diameter end milling cutter

to be shaped out in the lathe but enables the power feed of the machine saddle to be employed for doing all the hard work of cranking. Since the tailstock-mounted chuck does not revolve, the lathe can be run in the normal manner and the lead screw, or the ordinary longitudinal power feed, engaged to push the saddle and the slotting tool along the bed.

It is essential that the boring bar carrying the shaping tool be stiff and of as large a diameter as the hole in the work will admit. The clamping of the bar to the tool post must also be strong so as to prevent the bar from pushing back under pressure of the cut. The proportions of depth of cut taken per pass and the size of the bar are dependent on the size of the lathe. In the 8-in. lathe shown in Figs. 1 and 2 the depth of cut per pass for a shaping tool $\frac{3}{16}$-in. wide was 0.002-in. Experiment showed that the saddle could not be hand-cranked with this depth of cut.

Short-length external keyways or slots can be power-shaped in the lathe very easily, as shown in Fig. 3. A four-station tool post offers a firm hold to the slotting tool which can be a standard parting-off tool ground to the desired width of slot.

Blind-Ended Keyways

Blind-ended keyways of any length in long and slender shafts can be power-shaped most economically by the method shown in Fig. 4. The four-station tool post and short stubby shaping tool are employed in this example. The shaft is gripped at one end in the three-jaw tailstock mounted chuck to prevent it from turning and from shifting axially. The left-hand end of the shaft is supported by a center mounted in the headstock spindle nose and engaging with a center hole drilled therein. The center must be hard, since it revolves with the lathe spindle within the hole in the end of the stationary shaft. A ball-bearing center can be used with advantage, if one is available.

With a short and stiff shaft, the deflection under the pressure of the shaping tool will be negligible, but if the shaft is long and slender it is a good plan to mount the traveling steady on the lathe saddle so that it is in contact with the shaft and close up to the tool.

The keyway illustrated in Fig. 4 is blind-ended and some means must be provided for breaking off the chip formed by the shaping tool at the end of its travel. A shallow hole is drilled radially in the shaft and of a diameter equal to the width of the keyway. The shaping tool will run into this hole and the chip will snap off immediately, leaving a clean end to the keyway. It is useful to be able to use the lathe leadscrew for traversing the tool as the double-clasp nut can be disengaged more rapidly than the average longitudinal saddle feed.

Shaping tools work better if traversed at a fairly rapid rate. Since the connection of the screw-cutting gear train with the lathe spindle is usually through small diameter pinions, the strain on these can be reduced if a fairly high spindle speed is maintained and a coarse thread pitch selected by means of the screw-cutting gear box. For instance, the lathe shown in Fig. 4 was running on top spindle speed and the leadscrew revolving at a rate which would cut eight threads per inch.

fold along this line—outside edges toward you

Operator, using Metco gun, metal-sprays a 10-in. plug in two hours. Welding would have taken two days

Metallizing: Answer to Worn Valve Plugs

AFTER more than a year of careful study, the reclamation department of the Standard Oil Co. plant at La Habra, Cal., has found that metallizing is a "natural" for reclaiming worn valve plugs.

The reclamation department handles up to 5,000 valves yearly. Many were metallized, then placed in the field and refineries for testing. Metallizing came through with flying colors. One such reclaimed valve was in operation after more than a year, and the test as a whole indicated that this method would save the company thousands of dollars yearly.

Hard stainless steel has given the plugs a much greater life than before, and has been found to resist the corrosive action of chemicals, as well as the abrasive action of mud and sand pumped up during the drilling process. The photo shows an operator doing the job.

Tension Means Most to Joint Strength

THINK a bolt's greatest load-holding power stems from its size?

Not so, say Russell, Burdsall & Ward, fastener experts. Pre-load, or residual tension, in a tightened bolt means more to assembly strength than the actual strength of the bolt itself. In a joint, a bolt torqued to its proper load level resists a maximum amount of external load without loosening. Knowing this, gives better results at lower costs.

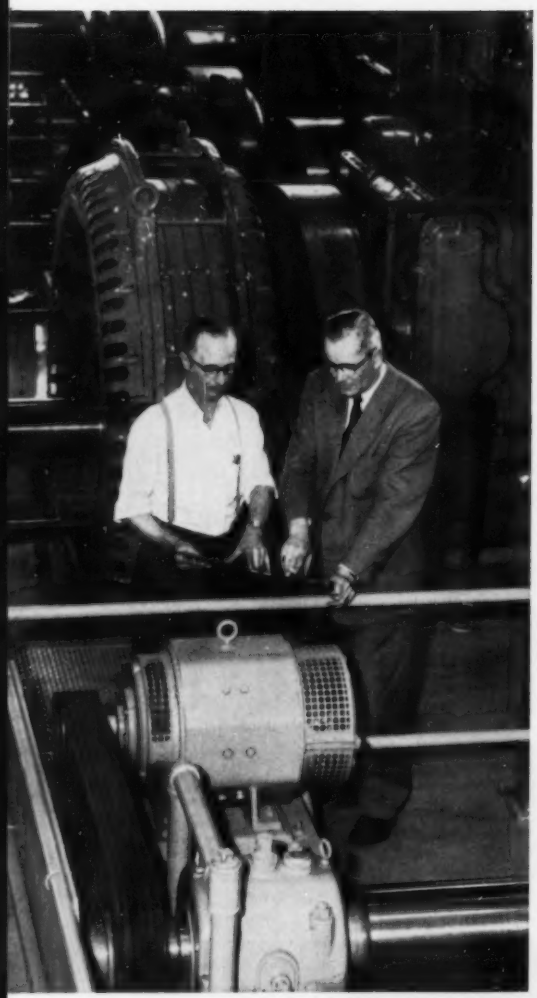
For example, one designer calculated high strength bolts at least $\frac{1}{2}$-in. in diameter were needed for truck frames. So he used $\frac{5}{8}$-in. to assure a safety factor. But on the assembly line these bolts were torqued to 100 ft-lb, whereas they needed at least 200 ft-lb for proper residual tension. The $\frac{1}{2}$-in. bolt at 100 ft-lb would actually have produced a stronger assembly at less cost.

As a rule-of-thumb, the more you stress a bolt within its elastic limit, the greater its ability to stay tight and make a strong assembly. And that's exactly what you want a bolt to do.

cut along this line

This utility gets better engine performance . . . less cylinder and ring wear with STANODIESEL Oil M

Report on Cumberland, Wisconsin, Municipal Utility's experience with diesel lubricants.



Clarence Maxcy (left), Chief Engineer at Cumberland, and Standard Oil lubrication specialist Ralph Rowlands check efficiency records of utility's engines lubricated with STANODIESEL Oil M. Providing technical service on lubrication problems is something for which Ralph Rowlands is well qualified. He has been doing this sort of work with Standard for 13 years. Ralph attended the University of Wisconsin and is a graduate of the Standard Oil Sales Engineering School.

Management of Cumberland, Wisconsin, Municipal Utility found a way to extend time between ring changes, to get greater fuel efficiency and to cut cylinder wear. How? By using STANODIESEL Oil M.

Before converting to STANODIESEL Oil M, the utility found it necessary to change rings every 1,500 to 2,500 hours. Cylinder wear ranged up to .003" per 1,000 hours of operation. After the engine was converted to STANODIESEL Oil M, it was run 7,800 hours at 50 to 90 per cent of full load. No rings had to be replaced during that time. The engine was then overhauled. All rings were free. All pistons were clean and in excellent condition. Ring wear was apparent on the two top rings only, bottom rings were like new. Cylinder wear after 7,800 hours averaged .003". This amount of wear occurred after 1,000 hours with the oil formerly used. On some cylinders, wear was only .001". Maximum bearing wear was .0005". Fuel efficiency over the period averaged 12.93 K.W.H. per gallon.

This kind of performance—reduced wear, increased fuel efficiency, improved overall engine performance—is what you can expect from STANODIESEL Oil M. Find out more. Call your nearby Standard Oil lubrication specialist. There is one near you in any of the 15 Midwest and Rocky Mountain states. Or write, Standard Oil Company, 910 South Michigan Avenue, Chicago 80, Illinois.

Piston from engine using STANODIESEL Oil M photographed just as it was pulled for 7,800 hour overhaul. Piston is clean and in excellent condition.

STANDARD OIL COMPANY
(Indiana)

STANDARD

Quick Facts About
STANODIESEL Oil M

- Is refined from highest quality base stock. Has superior stability.
- Contains special additives that:
  - Inhibit oxidation, control unwanted increases in oil viscosity.
  - Keep crankcase, pistons, cylinder walls and other parts clean.
  - Keep contaminants in suspension, prevent them from depositing.
  - Control foam, make oil suitable for use in hydraulic governors.
  - Increase the oil's ability to reach and maintain a film on highly stressed parts.

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Tips on Ball Bearing Maintenance

1 – Procedure and Devices for Ball Bearing Removal

NEARLY all failures of ball bearings during their removal from shafts can be prevented if the workman remembers that all pressure applied to a ball bearing must be applied next to the shaft (against the inner race). Nearly everything that has been written on this subject has merely repeated these instructions with varying degrees of emphasis.

Accompanying illustrations show a number of devices for driving or pulling bearings from shafts. It will be noted that all of these work against the inner race in one way or another. One of the primary things to remember when using any of these devices is that they are "dangerous if dirty." Even a hammer used in tapping off a bearing should be cleaned thoroughly before it is brought to bear on this job.

When bearings must be heated for removal, hot oil at 100 to 125 C should be used in applying heat. Again, however, it is very important that the oil be clean. Immersing the bearing in oil, which is being maintained within these temperatures, is the best method for heating, but it is possible to effect suitable heating with infra red lamps so mounted that all parts of the bearing

Fig. 1. If shaft has shoulder below bearing, rest shoulder on jaws of the vise and tap pipe lightly

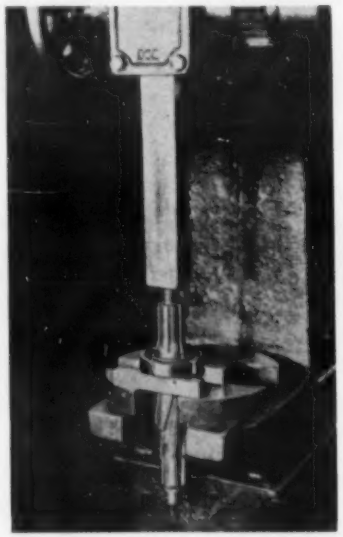
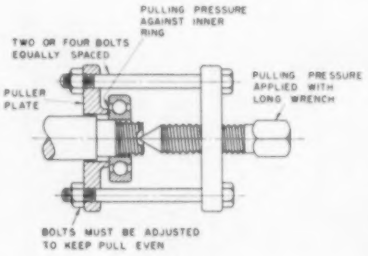


Fig. 2. Two steel blocks of equal thickness can be used to bear on inner race for press-removal

fold along this line—outside edges toward you

are receiving approximately the same amount of heat.

Though the use of pullers and presses is fairly well explained in the illustrations, it should be pointed out that force must be applied squarely to the inner race. Full angular contact between the puller plate and the inner race, with force being applied perfectly parallel to the shaft, prevents distortion of the race with subsequent binding of the balls.


PULLING PRESSURE AGAINST INNER RING
TWO OR FOUR BOLTS EQUALLY SPACED
PULLER PLATE
PULLING PRESSURE APPLIED WITH LONG WRENCH
BOLTS MUST BE ADJUSTED TO KEEP PULL EVEN

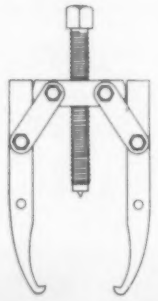


Fig. 3. Commercially-available bearing pullers come in various sizes—also work on inner race

2 – Stopping Oil Leaks

WHEN press-fit brass rings on the outboard bearings of rotating machines become loose, they cannot perform their intended function of centrifugally slinging off lubricating oil emerging from the bearings, and thereby returning it to the reservoir. This condition obviously can be corrected by boring out and installing a new fitted ring and, if the amount of wear or slack is very great, this procedure is to be advised. When loosening is noticed, however, the amount of slack is usually quite small and does not justify replacement of the ring.

Insertion of shim-stock under the rings would be very expensive and time consuming. A better procedure for taking up small amounts of slack in this fit is as follows:

1. Remove bearing cap.
2. Shift brass ring back and forth to thoroughly dry oil out from under the ring by wiping the shaft.
3. Shift rings to one side of running position, then brush on a thin coat of Permatex aviation gasket liquid and slide the rings back to their working position. Finally, apply another light coat of the liquid on each side of the rings, joining them firmly at the shaft.

The liquid will withstand hot oil, as well as the expansion and contraction of metal parts, and the slinger should work as good as new.

3 – Idle Bearings Wear Out, Too

IF MACHINES equipped with ball bearings are to be left idle for any appreciable length of time, it is very important that these bearings be cleaned and lubricated with a non-oxidizing grease. During long idle periods, many greases will undergo oxidation and form corrosive acids, which will stain and etch the races and balls of the bearings. When these bearings are placed in operation again, pitting and flaking follow and failure will occur in the near future.

Condensation or accidental wetting of an idle bearing can produce the same result. If there is any likelihood of either condensation or splashing from nearby equipment or rain, it would be wise to protect the bearing housing with a plastic or rubber shield, which can be tied onto the shaft and the housing. Lubrication at the time of shut down will also tend to fill voids which might entrap humid air or allow collection of moisture.

Even when these precautions have been taken, bearing failure can be caused by the accidental charging of the shaft or housing during a shutdown. An electrical circuit accidentally grounding

cut along this line

IS CORROSION EATING INTO YOUR CONDENSER'S EFFICIENCY?

When condensers operate at high capacities for long periods, tube failure occurs more frequently. Corrosion is accelerated by greater loads of water—carrying abrasives and debris—traveling at high velocities. The protective film normally formed by the metal is scoured away. Water can then act directly on tube walls—eating into your condenser's efficiency!

That's why the right copper-base tube alloy for your operating conditions—the alloy that gives the *best* corrosion resistance—can reduce your corrosion rate and frequency of re-tubing.

For example: *Service data and tests conducted in clean sea water show that Aluminum-Brass, Alloy #54, gives good service where water velocities are high. Where pollution exists, the best choices are Aluminum-Brass, Alloy #54, or Aluminum-Bronze, Alloy #53.*

When replacing old condenser tubes—or specifying new ones—be sure you take full advantage of all latest developments. Bridgeport Condenser Tube Alloys are matched to your corrosion conditions for longer life, reduced maintenance. Our Technical Service and Corrosion Laboratory will be glad to help you select the *right* alloy. Phone your nearest Bridgeport Sales Office today.

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BRIDGEPORT CONDENSER TUBES

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through equipment or arc-welding a mounted shaft will probably cause arcing across the ball faces in the bearing. When this occurs, the highly polished races and balls will become etched at the point of arcing and subsequent operation will cause rapid failure. If such short circuits occur, and it can be seen that a path to ground would pass through equipment bearings, it is generally advisable to replace the bearings at first opportunity.

4 — Jig Holds Self-Aligning Bearings for Boring

SPLIT-TYPE ball seat bearings for high speed machines can be quickly and accurately machined with the aid of this simple holding device. The fixture (see illustration) consists of a tapered shank to fit the lathe's spindle and a ball seat to receive the bearing, the holding nut (which screws onto the outside of the first part and locks the bearing in place), and a square-faced center, which fits into the tail stock.

In normal use, the bearing is seated in the first part, the holding nut is lightly tightened over the bearing to secure it in its seat, and the center is mounted in the tail stock and brought up against the face of the bearing to square it with the lathe. When the bearing is square, a spanner wrench is used to tighten the holding nut over the bearing and the tail stock is withdrawn to expose the bore and face of the bearing. Machining operations can be performed on all exposed surfaces of the bearing without danger of springing or distorting the body, which is a distinct possibility when the standard four-jawed chuck is used.

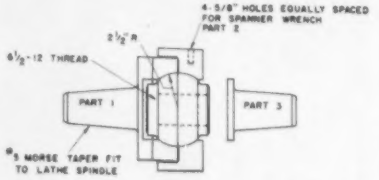


Fig. 4. A three-part fixture for holding split-type ball seat bearings for machining in a lathe

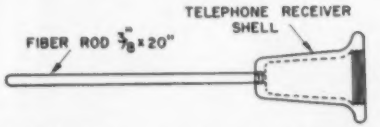
5 — Stethoscope for Bearing Maintenance

THOUGH most of us are familiar with the standard steel sounding rod, used to pick up the sound of bearing operation, the best industrial stethoscope we have seen was submitted some years ago by W. T. Widmaier and was developed in the shops at Westinghouse. This device (see illustration) consists of a fibre rod ⅜ in. in diameter and 20 in. long, threaded at one end and screwed into the cord outlet of an old-fashioned telephone receiver. The internals of this receiver were removed to leave a hollow shell. The open end of this receiver is held over the ear (rather than against the bone behind the ear as with a steel rod) and the fibre rod is pressed against the bearing housing.

When a steady hum is heard in the bearing, all is well. A click, heard at irregular intervals, indicates that there is dirt or some foreign matter inside the bearing. If this click occurs at regular intervals, it is likely that flat spots are beginning to develop on balls within the bearing. Regular clicks can also indicate cracks or fatigue spots on the inner or outer races.

Dry bearings in need of lubrication generally give forth a rattling sound that is readily identifiable when once heard. It should be noted, by the way, that bearings designed for grease lubrication should never be heavily coated with fluid oils before assembly into the equipment; certain greases do not adhere well to bearings so treated.

It is said that this stethoscope is so sensitive that, with practice, moving grease can be heard inside the bearing when it has been overlubricated. As with any stethoscope, frequent use is required for the development of an instinct in identifying troubles from their sounds.



Industrial stethoscope can be made of telephone receiver shell or 1½ x 8-in. micarta tube with a hardwood block fitted in one end, drilled for rod

fold along this line—outside edges toward you

Vapor Recording Method Aids in Solving Moisture Problems

DEVELOPMENT of a continuous, automatic method and instrument for recording low concentrations of water vapor in air or gas streams is reported to offer a solution to some moisture problems in industries and gas pipelines.

The method, operating on 4-min. measuring cycles, has been used in instruments with a full scale range of 100 ppm water by volume and appears satisfactory with lower full scale ranges; instruments can be made which will record higher ranges. A sensitivity of 0.25 ppm by volume has been reportedly attained. Accuracy is limited by noise level and calibration errors to about 1 ppm.

Developed by Mine Safety Appliances Co. and Esso Research and Engineering Co., this method is expected to be of value in monitoring dryness of natural gas in long pipelines. The instrument will serve as a means of monitoring gas so that conditions under which hydrates form can be avoided.

Also, the high efficiency of drying towers can be maintained if the water content of the effluent gas is closely monitored so that regeneration is applied before, or at the time of, the first water break-through. Also, it can be used to prevent moisture damage to certain process catalysts by monitoring feedstreams.

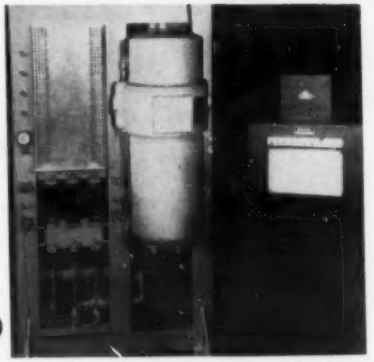


Fig. 1. A complete thermoelectric instrument for measuring and recording low concentrations of water vapor continuously in air or gas streams. Recorder and timer are designed for remote locations

The principle of operation is based on the heat energy exchanged when a gas is absorbed on or desorbed from the surface of a solid adsorbent. A continuously flowing sample of gas is split into two equal streams, one of which is dried completely by a regenerative adsorption column. The two streams are then directed alternately through two sides of a detector cell by means of automatically timed and operated 3-way valves. During 4-min. cycles the dessicant in each

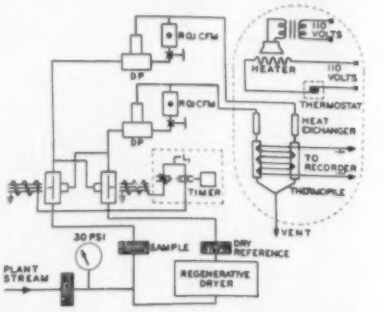


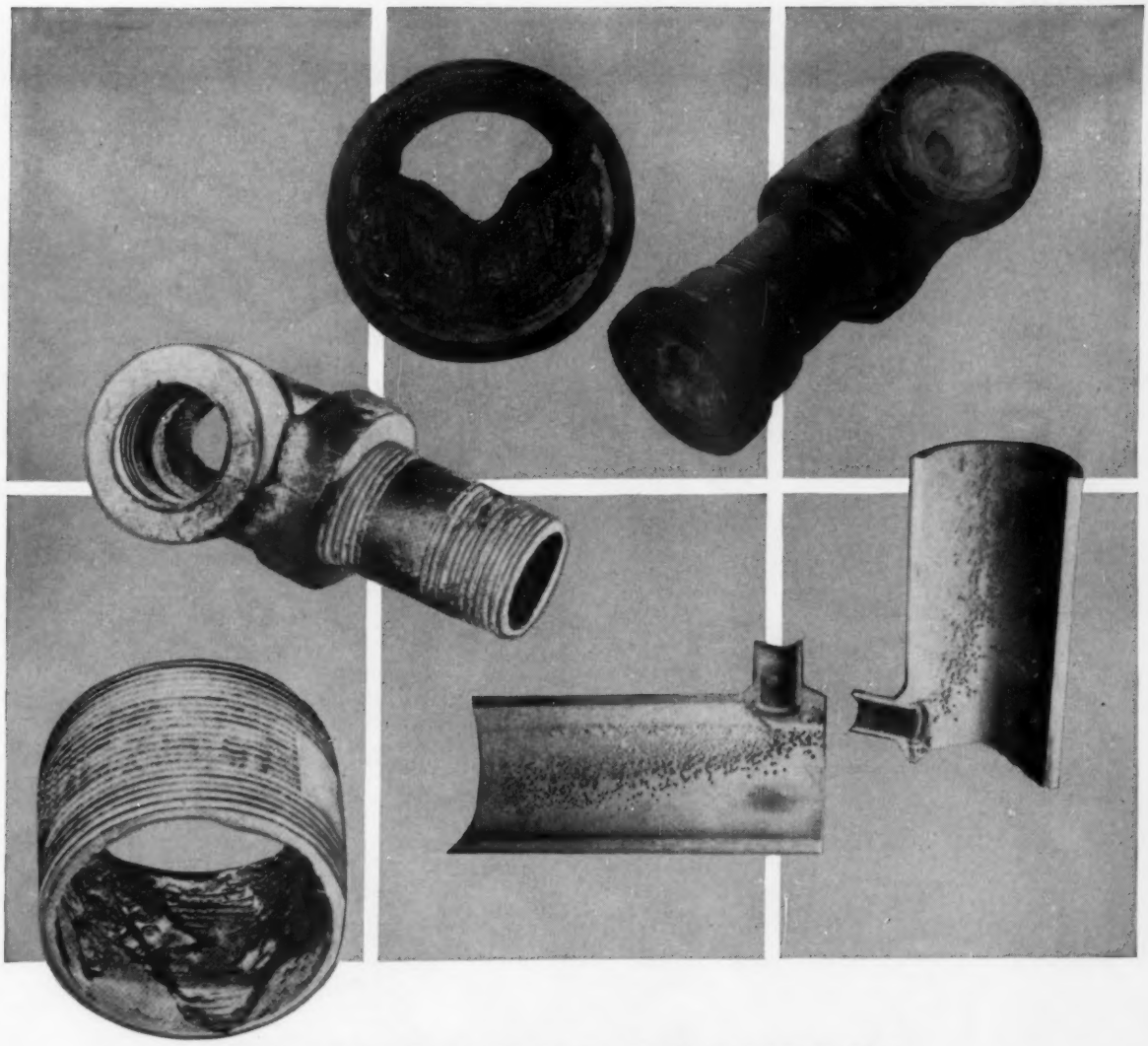
Fig. 2. Flow diagram of instruments developed for continuous measurement of the water vapor in a gas

side of the cell is exposed alternately to each stream for two minutes.

A number of thermocouples in the two dessicant beds are connected in a circuit to develop an electrical potential. Since both adsorption and desorption processes proceed simultaneously, the resulting emf is proportional to the algebraic sum of the gain of heat on one side of the cell and the loss of heat on the other side.

During each half cycle, the temperature differential in the cell rises rapidly, passes through a maximum and then diminishes slowly. When the maximum is passed, the flow is switched and the moisture and temperature equilibration process is repeated. In the second half cycle the dessicant and stream which had lost heat in the previous half cycle gain heat and the reverse process takes place in the other side of the cell. The emf generated is equal but of opposite polarity to the previous half cycle.

cut along this line



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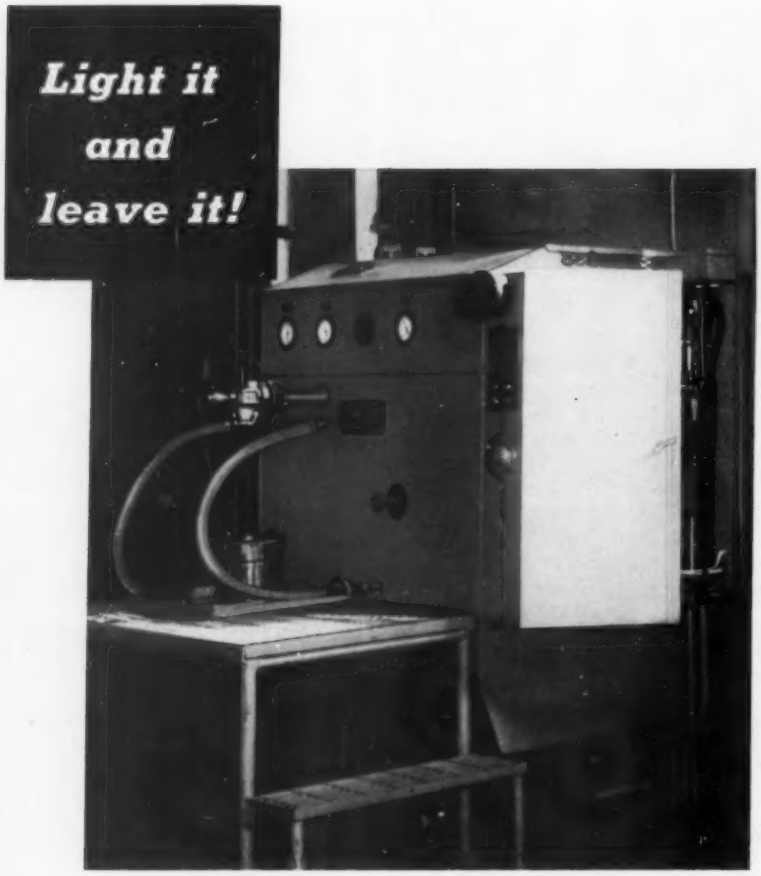

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Paper Mill

continued from page 68

potential transformers of the tie circuit. The sensing networks control the output of the regulators which in turn cause operation of the:

a. Turbine's speed changer motor for kw corrections, or

b. Turbine's hydraulic cup valve actuator for kw corrections,

c. The generator voltage regulator compensators for var corrections, or

d. The transformer underload tap changer for var corrections, in the power tie circuit.

Load regulators may be of the following types:

1. Magnetic amplifier controlled power output,[1 2 3]

2. Rotating regulator controlled power output, [4 5]

3. Electronic tube controlled power output,[5]

4. Balanced beam relay controller,

5. Balanced bridge circuit controller.

Of these 1, 2, and 3 have the fastest speeds of response, and are accurate enough for most tie circuits. Their circuits are usually somewhat complicated which is reflected in higher equipment cost compared to 4 and 5. They are preferably used to control systems (a), (b), and (c).

Types 4 and 5 are simple, of lower cost and sufficiently accurate for most applications. They are best used to control systems (a) and (d).

When energy is purchased on a block kilowatt demand basis, minimum cost occurs when, at the end of each demand period, the number of kilowatt hours permitted by the demand interval has been consumed.

One solution to this problem is to superimpose the control of a kilowatt hour integrator on that of the constant kilowatt regulator. The integrator continuously recalibrates the regulator according to the actual as compared to the permissible rate of energy consumption, so that at the end of each demand period, essentially the total allowable kilowatt hours have been purchased.

The need for reactive power regulators has not been as great as for the real power types. They operate on essentially the same principles as real power regulators.

The foregoing data were adapted and specially rewritten for POWER ENGINEERING by the authors from their AIEE paper. In a future article, they will cover additional mill power problems.

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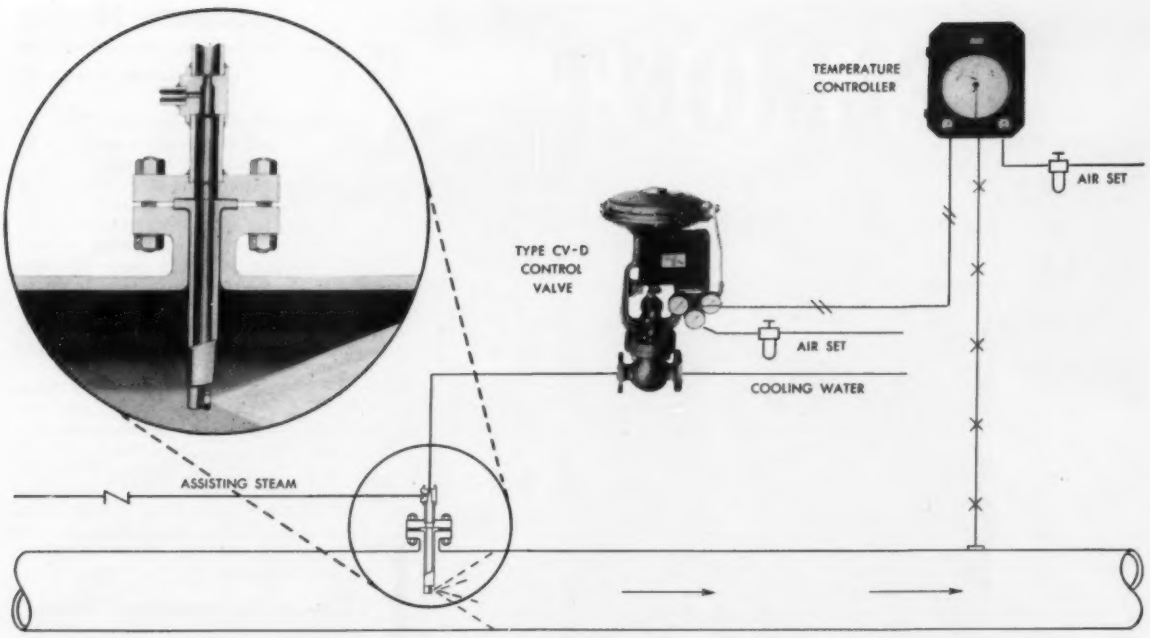
[4] Industrial Application of Rototrol Regulators, W. R. Harris. *Electrical Engineering*, March 1946.

[5] Rototrol Excitation Systems, J. E. Barkle and C. E. Valentine. *AIEE Transactions*, Volume 67, 1948, pages 529-534.



Normal installation of a Copes-Vulcan Steam-Assist Desuperheater is shown schematically

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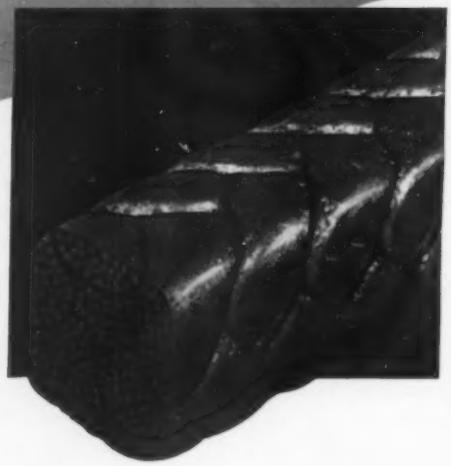

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Feedwater Heater

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the receiver at the bottom. The receiver is held at the same pressure as the highest extraction stage.

The highest pressure extraction steam is first desuperheated in the closed heater, and enters the receiver at approximately saturated condition. The condensing zone for this closed heater is completely open to the steam space in the receiver. Condensed steam (drains) is automatically included in the receiver liquid space.

Inasmuch as the feedwater temperature at the boiler feed pump suction is below that for vaporization, these pumps operate under a positive suction head at all times. With this design, net positive suction head for boiler feed pumps is no longer a station design factor. The original paper contains full details of the operation of the K-F heater.

Control System for K-F Heater

Control system for the K-F heater is designed to maintain a practically steady flow to each heater for a given load on the turbine, thus minimizing fluctuations in the extraction line pressures. Basically, the control system for each stage is made up of three elements: (1) primary demand, (2) correction for head variation and (3) correction for flow to the succeeding stage.

Heat rate for the regenerative cycle when using the K-F feedwater heater, combined with a closed heater, is stated to be better than that of the same cycle employing conventional closed heaters.

Heat balance diagram (given in the paper, but not shown here) for a 150,000-kw, 1800-psig, 1000-F/1000 F, 1½-in Hg preferred standard turbine generator, with 7 stages of feedwater heater, shows a heat rate at 150,000-kw net output of 7953 Btu per kwh.

New K-F lock arrangement described is applied to the single deaerating-heater installation for industrial use. The heater can be located at the same level as the boiler feed pumps, thus eliminating expensive supporting structure. In addition, savings will be made in the reduction of the boiler-feed-pump horsepower and initial pump costs.

Where boiler drum pressure is maintained on the boiler-feed-pump suction, pumping horsepower need only overcome static head plus friction drop in piping.

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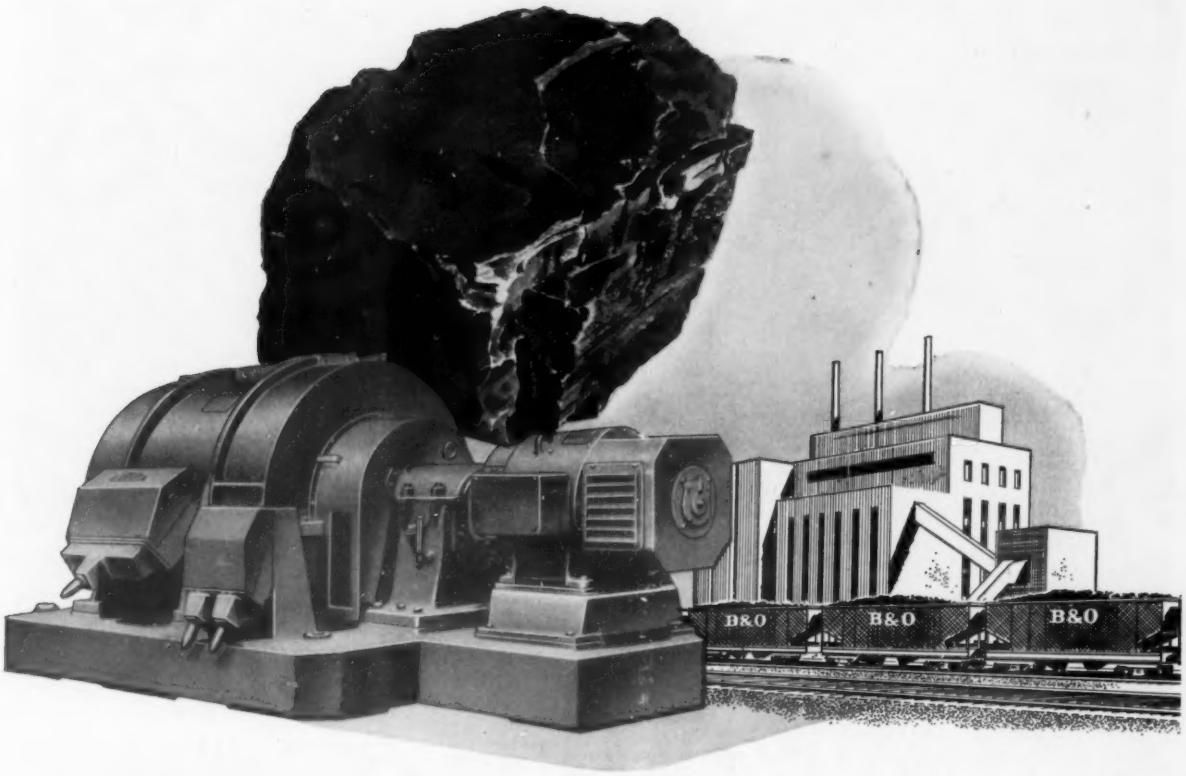

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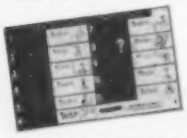

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NEW ENGINEERING BOOKS

Electric Generation — Steam Stations, edited by Bernhardt G. A. Skrotski. Size 6¼ by 9¼; 454 pages including index; cloth binding. Published by McGraw-Hill Book Co., 327 W. 41st St., New York 36, N. Y. Price $8.50.

This book describes basic principles of the steam-electric generating stations which provide most of the electrical energy in the United States. It gives facts on selection of fuel, feeding it to boiler furnaces, and the design and operation of steam generators and fuel-burning equipment. The book is designed to give the reader without much technical background a practical knowledge of the design, maintenance, and operation of the equipment that makes up an electric-supply system.

Piping, turbines, condensers, the treatment of feedwater and cooling water are covered in detail. Also considered are station control methods of handling complex circuits.

Recommended for all steam station personnel who want to know more about the *why* of their jobs.

★ ★ ★

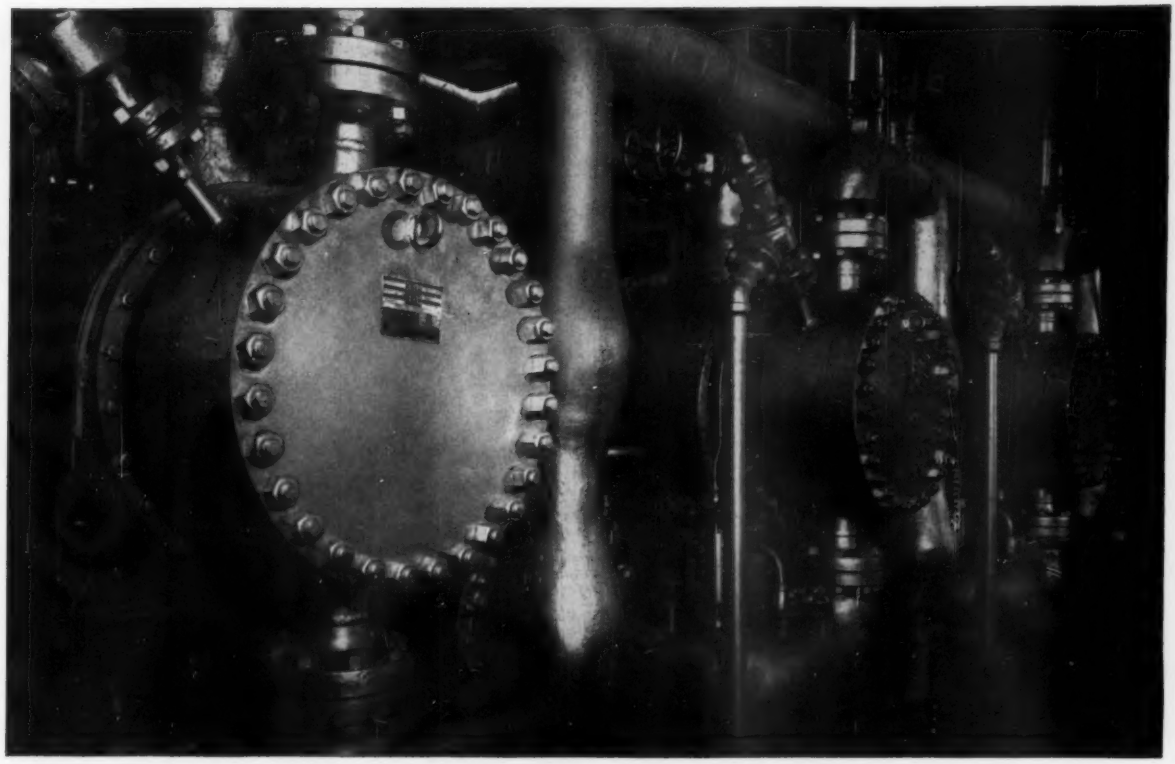
Proceedings of the World Symposium on Applied Solar Energy, sponsored by The Association for Applied Solar Energy. Size 8½ x 11"; 304 pages; illustrated; cloth binding. Published by the Stanford Research Institute. Order from Association for Applied Solar Energy, 204 Heard Building, Phoenix, Ariz. Price $5.00.

The Association for Applied Solar Energy was formed in Phoenix, Ariz., on March 17, 1954. The main purpose of the Association is to hasten the utilization of the sun's energy. One of its first actions was to request Stanford Research Institute to plan and organize two major meetings on applied solar energy. The first was a two-day Conference on Solar Energy — The Scientific Basis, which was held in November 1955 at Tucson, Ariz. This was closely followed by the World Symposium on Applied Solar Energy at Phoenix.

Support of these meetings was remarkable. The Conference and Symposium were attended by more than 900 registrants, and the Solar Engineering Exhibit, held in conjunction with the Symposium, was attended by nearly 30,000 persons. An indication of the world-wide interest in the subject of solar energy was shown by the fact that more than 130 delegates came from 36 countries outside the United States.

At the Conference 96 papers were presented on the technical and scientific aspects of solar energy. Plans are being made for publication of these papers.

The papers presented at the Symposium, dealing with the more practical aspects of



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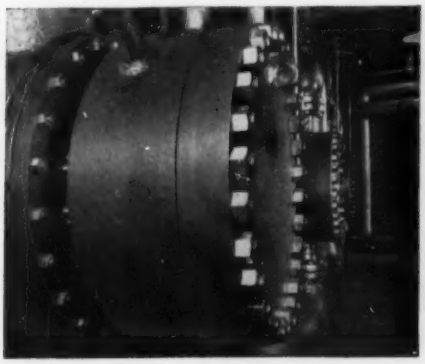

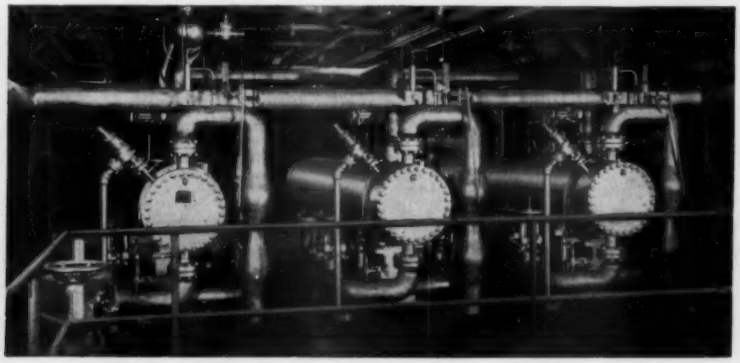

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Engineering Books

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applying solar energy, are contained in the present volume. To give an idea of the range of subjects covered by the Symposium, the papers presented include the following: The Economics of Solar Energy, by J. E. Hobson; Solar Machines, by Nathan Robinson; High Temperature Furnaces, by Felix Trombe; Solar Stills, by Maria Telkes; Residential Uses of Solar Energy, by Jordan and Ibele; The Heat Pump and Solar Energy, by Philip Sporn and E. R. Ambrose; Cooling with Solar Energy, by O. G. Lof; Mechanical Energy from Solar Energy, by R. C. Jordan and W. E. Ibele; Solar Water Heaters by R. N. Morse; Growing Chlorella for Food and Feed, by Hiroshi Tamiya; Engineering for Algae Culture, by A. W. Fisher, Jr.; Direct Conversion of Solar Energy, by Paul Erlandson; Electricity from the Sun, by G. L. Pearson; and Converting Solar to Chemical Energy, by L. J. Heidt.

In addition to these and other papers, the Proceedings contain the texts of addresses given before the Symposium by such well-known figures as Lewis W. Douglas, the General Chairman of the Symposium; Dr. Farrington Daniels, of the University of Wisconsin, John Jay Hopkins, Chairman and President, General Dynamics Corporation, and many others.

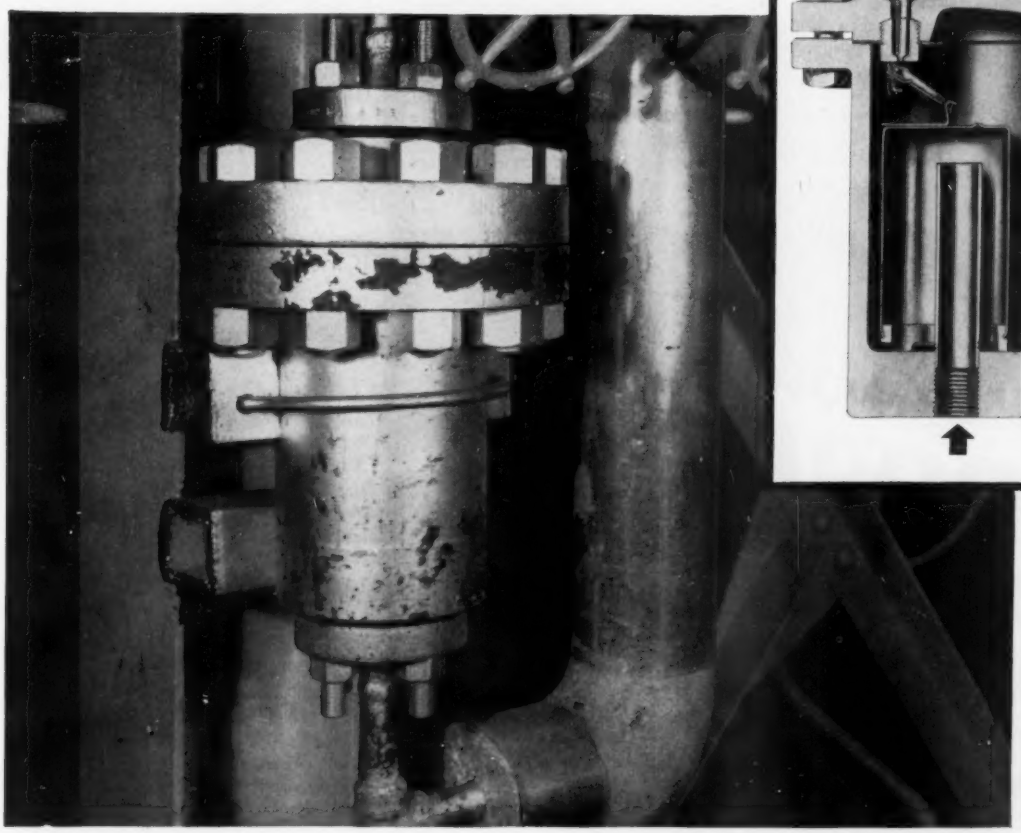
Of particular interest to power engineers are the papers on Mechanical Energy from Solar Energy and on Electricity from the Sun. In the first is a table showing experimental power systems developed in the past century in various parts of the world. This table occupies 3½ pages. Data are given on actual installations of solar power plants, many of them more sensational than practical. No fully developed system to date has shown economic feasibility. The limitations and possibilities are thoroughly discussed and compared with existing methods of power generation.

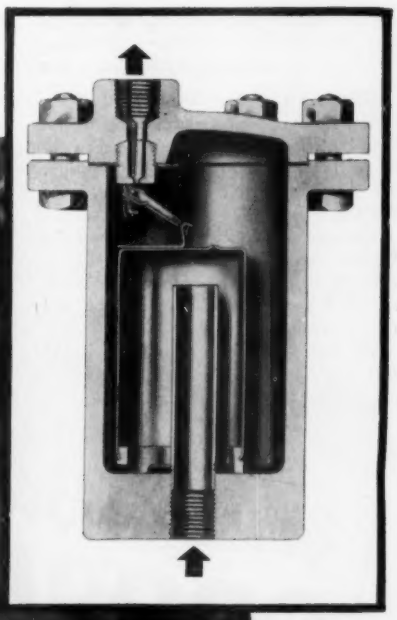
In the second paper, Electricity from the Sun, describes in detail the new silicon solar-energy converter developed by Bell Telephone Laboratories.

This whole volume is fascinating reading; for one thing, the explanations are well-written, with a minimum of mathematics and with many graphs and tables, so that any engineer can group them easily. The general conclusions are that no one of our forms of potential energy — fuel, hydraulic, atomic, solar — should be played off against another. Instead, we should consider the most profitable combination of the various sources. From this point of view, certainly the present research in solar energy is worth while and, as John Yellott pointed out, may affect the lives of millions of people living in the solar belt, who may have no other fuel resource.

This book should be of value to all power engineers in giving them a broader view of both the practical and economic aspects of all energy conversion.

ARMSTRONG FORGED STEEL STEAM TRAPS . . .





. . . the Best Answer to Superheated Steam Line Drainage, because:

LIST OF MATERIALS
ARMSTRONG FORGED STEEL TRAPS

Part	Material
CAP AND BODY FORGINGS	
Up to 600 psi, 750°	1030 carbon steel
Up to 900 psi, 900°	ASTM Spec. F-1 carbon moly steel
Up to 2500 psi, above 900°	ASTM Spec. F-5 chrome moly steel
VALVE AND SEAT	Type 440 chrome steel, heat treated, standard. Stellite available.
LEVER MECHANISM	Stainless steel
BUCKET	Stainless steel
BOLTS	Class C high tensile, high temperature bolting material—125,000 min. tensile.
NUTS	Hex, semi-finish, heat treated for high pressure, high temperature service.
GASKET	Compressed graphited asbestos
INLET TUBE	Wrought iron

1. **Proved** in service in leading power plants throughout the world at pressures to 2400 psig.

2. **Experience** of Armstrong in design, manufacture and application dates back to the *beginning* of the trend to higher and higher pressures.

3. **Automatic** safety assured because of high capacity for warm-up loads; traps don't "forget" to drain the lines, and Armstrong traps *always* open for condensate.

4. **Economy** assured because of high value for price, long life with infrequent maintenance and freedom from steam loss.

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2. **Catalog J**—complete data on forged steel traps and steam trapping.

Application Engineered
STEAM TRAPS

ARMSTRONG MACHINE WORKS, 810 Maple Street, Three Rivers, Michigan

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Engineering Books

continued from page 108

Electrical Circuits — Direct and Alternating Current, by Charles S. Siskind; size 9¼" by 6¼"; 516 pages; cloth bound. Published by McGraw-Hill Book Company, 330 W. 42nd St., New York, N. Y. Price $6.75.

Two-semester basic textbook covers the fundamental principles of electric and magnetic circuits. It is designed for use at college, technical institute, vocational school, and industrial levels.

The book covers both a-c and d-c circuits and numerous examples at the end of each chapter help to illustrate the significant points in the chapter.

The direct current section contains the following chapter titles: 1. Basic electrical ideas and units; 2. Wires, cables and insulation; 3. d-c circuits — Ohm's Law — power-energy; 4. d-c circuits — Kirchhoff's Laws — basic theorems; 5. Magnetism and magnetic fields; 6. Magnetic circuits; 7. d-c instruments and measurements; 8. Inductance and electromagnetic induction; 9. Capacitance and dielectric circuits.

The alternating current section comprises the following chapters: 1. Sinusoidal voltages and currents; 2. Resistance, inductance and capacitance circuits; 3. Parallel and series — parallel circuits; 4. Resonance in series and parallel circuits; 5. Circuit analysis by Vector Loci; 6. Network laws, theorems and principles; 7. Coupled circuits and mutual deduction; 8. a-c instruments and measurements; 9. Polyphase circuits; 10. Nonsinusoidal waves.

This book, together with Mr. Siskind's *Electrical Machines*, provides a comprehensive text for the fundamentals of circuit theory and practice for a-c and d-c machines.

★ ★ ★

Standards of the Hydraulic Institute. 10th Edition. Size 11½ by ¾ in.; approx. 191 pp; illustrated; loose-leaf binding. Published by Hydraulic Institute, 122 East 42nd St., New York 17, N. Y. Price $4.75. (U.S.A.)

Power engineers should find this tenth edition of the publication handy to have. It contains a good deal of information encompassing various classes of pumps, terminology, application and rating standards, and instructions for installation, operation, and maintenance.

Material on centrifugal pumps includes drawings of various classes of equipment in this general group. These are detailed by means of numbered arrows. The numbers are used as a cross reference in a "master" table that contains names and definitions of respective parts.

The section on rotary pumps includes a classification breakdown by types such as gear, lobe, screw, vane and shuttle block. Under the notebook division of reciprocating pumps two general classes are covered, namely steam and power pumps.

A separate data section offers a collection of tables pertaining to such items as friction losses per 100 ft of pipe, pipe dimensions, equivalent pipe lengths for different valves and fittings, properties of iron and steel pipe, and viscosities of various materials.

★ ★ ★

Thermodynamics, by Ray L. Sweigert and Mario J. Goglia; 355 pages; size 6½" by 9½"; cloth cover. Published by The Ronald Press Company, 15 E. 26th St., New York 10, N. Y. Price $6.50.

The authors are teachers, and the book itself is an engineering textbook. It develops several unique graphical presentations of the familiar laws of thermodynamics and their applications. Each topic is developed by using information and ideas already known to the students, then introducing real examples to stimulate the desire for more knowledge, and finally presenting the theoretical discussion pertaining thereto. It seems like a good way to plant theoretical concepts in the minds of those meeting the subject for the first time.

For practicing power engineers, the greatest value in such a book will probably lie in the index (which is adequate) and in the tenth chapter devoted to applied thermodynamics. This chapter takes most of the familiar power cycles and equipments used in producing or utilizing power and re-explains them in terms of the theoretical thermo presented in the first nine chapters.

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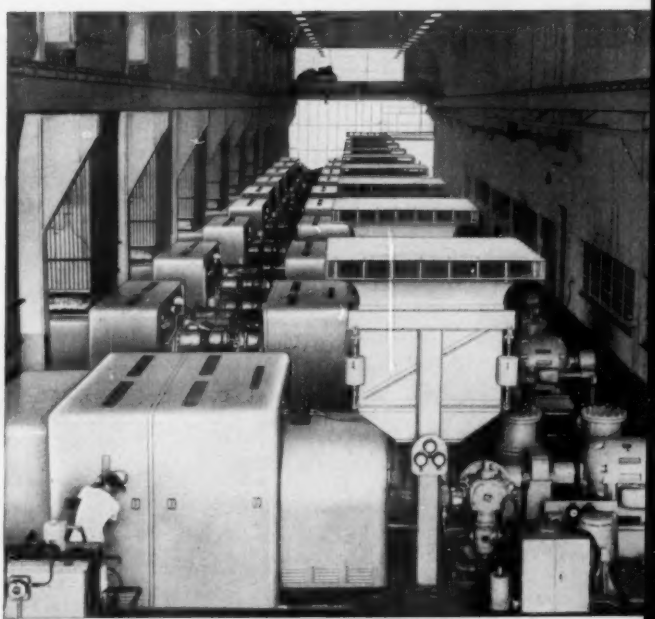
GAS TURBINE
OPERATING REPORT

Why General Electric is proud of Creole Petroleum's "Gas Turbine Island"

Seven miles out in Venezuela's Lake Maracaibo stands a unique example of the petroleum industry's constant search for new and better methods of conservation—Creole Petroleum Corporation's Tia Juana No. 1 Conservation Plant. Here, ten General Electric gas turbines drive compressors to return previously flared gas under pressure to the underwater oil field, thus increasing Creole's oil yield.

Accumulated data prove that the performance of the ten G-E gas turbines has exceeded all expectations. In the first thirteen months, during which time the machines accumulated 89,000 hours of operation, availability of individual turbines was a remarkable 98 per cent. In fact, unscheduled gas turbine downtime has never caused the plant to shut down. Originally planned to pump 137 million standard cubic feet of gas per day, the platform has pumped as much as 170.8 million cubic feet per day on a weekly average.

Versatile, economical, compact G-E gas turbines are already at work in a diversity of applications. Why not check into the advantages they can bring to your operation? Your nearest G-E Apparatus Sales Office can furnish you complete information. General Electric Co., Schenectady 5, New York. 261-21



PUMPING 24 HOURS A DAY, compressors driven by General Electric gas turbines maintain pressure in Creole Petroleum's vast oil fields under the waters of Lake Maracaibo, increasing the recovery of oil and conserving large volumes of gas for future use

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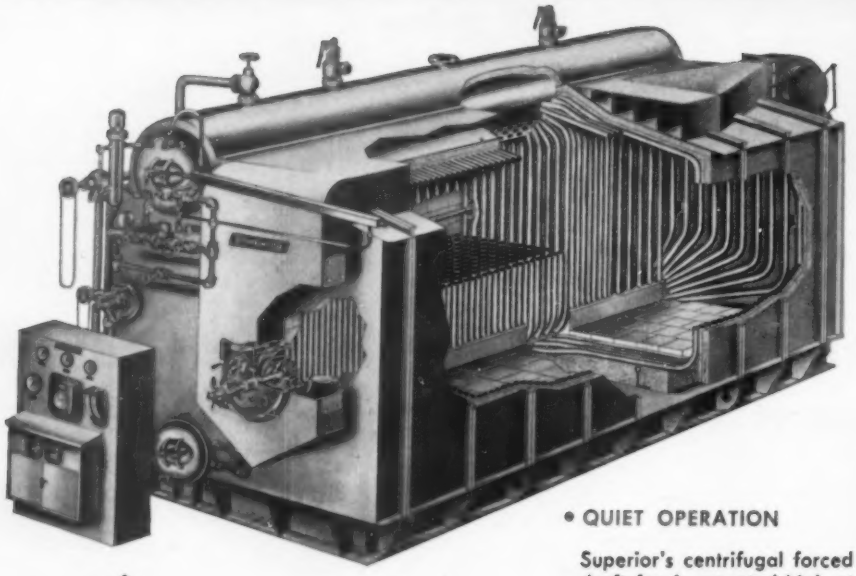
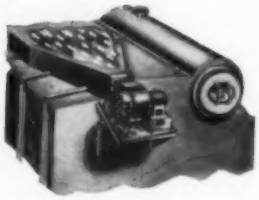
A true packaged boiler with capacities to 50,000 lbs. per hour . . . completely factory assembled . . . with plus features not commonly found on other packages.

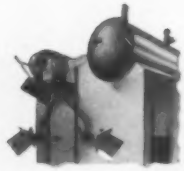
All that a Water Tube Package SHOULD be PLUS





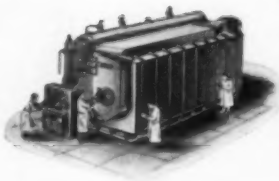
• QUIET OPERATION

Superior's centrifugal forced draft fan is mounted high at the rear of the boiler to provide quiet operation and an uncluttered firing front. Over-the-furnace air duct cools the furnace roof and provides better air distribution to the burner.



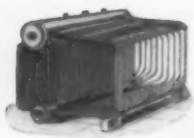
• AIR-COOLED OBSERVATION PORTS

An exclusive Superior Feature which utilizes air from the forced draft fan to provide a cooling shield at the observation ports, eliminates the danger of observing a fire in a pressurized furnace through an open port.



• FIRE TESTED

A distinct advantage of this truly packaged unit is factory fire-testing. Every Superior Steam Generator must achieve its guaranteed performance rating before shipment.



• TANGENT TUBES IN LARGE FURNACE

Released heat in the furnace is quickly absorbed in the tangent tubes, which are all riser elements providing rapid circulation and discharge directly into the steam drum.

There's no guesswork about Superior Steam Generators. They are designed, engineered, built and tested by Superior Combustion Industries, Inc. whose boiler division specializes in the exclusive manufacture of packaged steam generators. For complete details write today for Catalog 806 D.

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BOILERS, GENERATORS

201 Packaged Boilers — This 16-pp illustrated catalog describes manufacturer's new Type VP package boiler. Following a section of background information is an outline of the principal design features of these boilers, which are shop assembled and provide steam capacities from 4000 to 40,000 lb per hour. Space requirements are shown in a table along with typical specifications. Also described is control system. Combustion Engineering, Inc.

202 Compact Generator — This bulletin describes a packaged water tube generator, company's Type DK, available in units for 8400 to 45,000 lb of steam per hour. Gives features, size and capacity data on these boilers which are designed to require less space than many water tube units. E. Keeler Co.

203 Improved Steam Generator — Bulletin 2000, 28 pp, explains advance design features that distinguish this manufacturer's generator from other unit steam generators. Describes and illustrates engineering differences of component features. Also shows how these components are constructed, assembled and tested. Another section gives data, and dimensions for the units which range from 20 to 6000 hp. Preferred Utilities Mfg. Corp.

204 Steam Generators — Illustrated Bulletin SB43, 20 pp, describes company's VL factory assembled generators combining 2-drum water-type boiler, integral water cooled furnace, brick work, insulation and steel casing. A large cutaway illustration shows design details, and gas travel. Erie City Iron Works.

It's easy to get these free catalogs—just circle item numbers of those wanted on the post card at right.

205 Packaged Generators — Bulletin MH 3-54, 14-pp, gives detailed coverage to company's Type MH packaged water tube steam generators which are furnished for oil or gas firing or both, with automatic, semi-automatic, or manual controls. Included are: cutaway illustrations, installation photos, tube arrangement layouts, construction details, auxiliary equipment, dimensions. Union Iron Works.

206 Automatic Boilers — Bulletin BE-4 describes operation and advantages of Continental automatic boiler's spinning gas technique — a method of obtaining maximum heat transfer with a simplified design. Shows cutaway view of boiler construction; illustrates hinged doors and method of injecting air through static, turbine-like vanes into burner. Boiler Engineering & Supply Co., Inc.

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207 **Water Tube Boilers** — This 12-pp catalog describes packaged water tube boilers, capacities to from 8000 to 50,000 lb per hour. Interesting as well as informative, this booklet uses color and illustrations to amplify text. Gives complete data and dimensions for boilers designed for firing oil or gas or both. Superior Combustion Industries, Inc.

208 **Shop-Assembled Boiler** — Sixteen-pp Bulletin G-76 completely describes and illustrates company's Type FM water-tube integral-furnace boiler, made in standard sizes from 2900 to 28,000 lb of steam per hr, pressure to 250 psi. The Babcock & Wilcox Co.

209 **Packaged Generators** — This 16-pp catalog covers a new series of packaged steam generators in sizes from 10,000 to 46,000 lb of steam per hour. Gives capacities, dimensions, construction features. Instrumentation is discussed. Illustrations include sectional drawings and installation photos. Booklet also provides a selection chart covering firing equipment and controls. Foster Wheeler Corp.

TUBING AND ACCESSORIES

210 **Rotary Tube Cleaners** — Bulletin R-105 presents air and water driven rotary tube cleaners and cleaner accessories. Illustrates several models and heads. Roto Div., Elliott Co.

211 **Nickel Pipe and Tubes** — Bulletin T-17 is a 28-pp technical bulletin on the fabrication and design of nickel and high nickel alloy pipe and tubing, illustrated throughout by drawings and photos. Presents tables on mechanical and physical properties, ASME code requirements, recommended welding procedures. The International Nickel Co., Inc.

212 **Life Extension for Condenser Tubes** — The 32-pp current edition of this booklet reports on research into the causes of corrosion and means of combating them, as well as the choice of condenser tube materials. Points out that Admiralty metal, long a standard for power plant condenser tubes, works satisfactorily in most installations, but other alloys may be necessary in some circumstances. Revere Copper and Brass, Inc.

213 **Tube Cleaners** — Catalog 76-A provide 48 pp of information on manufacturer's line of tube cleaners. Following equipment selection and operating hints, this practical catalog describes and pictures cutter heads and drill heads, brushes, and motors, giving sizes, application information. Thomas C. Wilson, Inc.

FUEL BURNING EQUIPMENT

214 **For Burning Refuse Fuel** — This 8-pp bulletin describes refuse fuel burning equipment, including a pneumatic refuse fuel distributor which spreads refuse fuels such as bark, wood chips, and bagasse uniformly over the grate surface. Discusses construction features of various components, the selection of grates, as well as pertinent design and engineering features. Riley Stoker Corp.

215 **Steam Atomizing Oil Burners** — Sixteen-pp illustrated Bulletin 21 describes steam atomising oil burners and auxiliary equipment for use with heavy oil or tar in boilers, stills, dryers and other furnaces, where steam or compressed air

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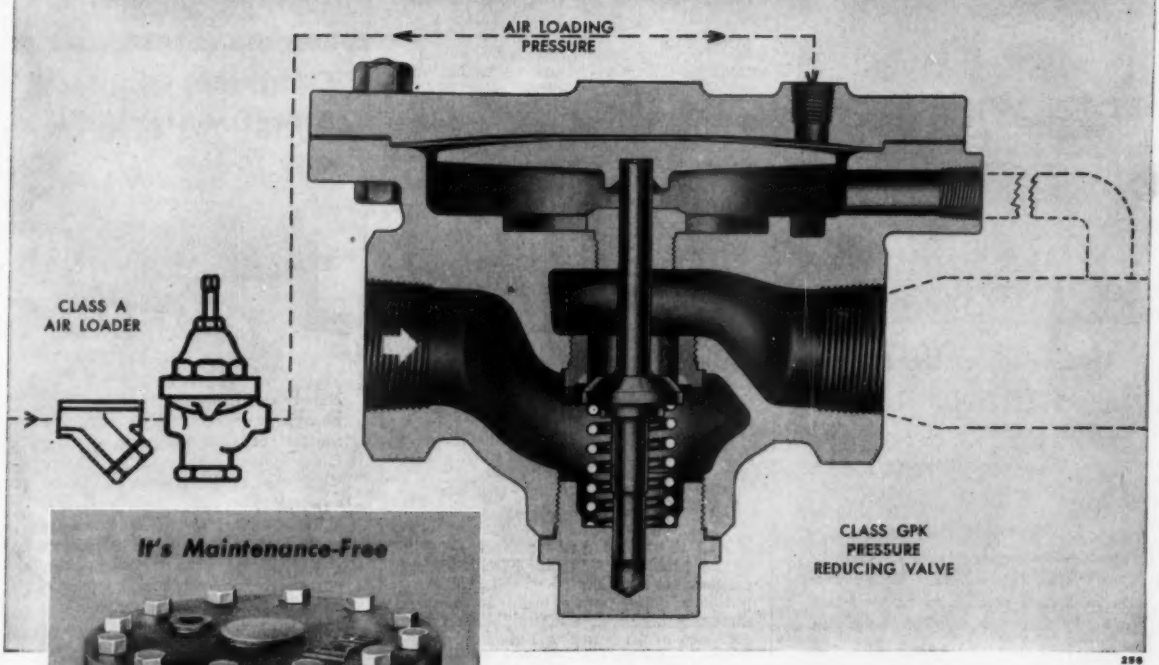

You can just put this amazingly simple and compact Leslie Class GPK-A pressure reducing valve on the line and forget it for at least 3 years!

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Your Leslie engineer can give you all the data on this amazing valve. You'll find him listed in your classified directory under "Valves" or "Regulators".

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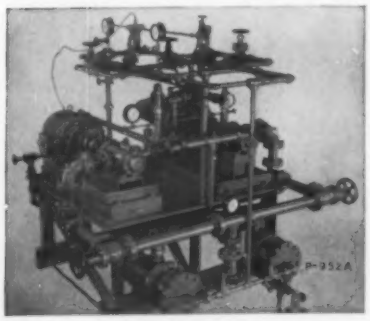

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is available for atomizing the oil. Includes information on furnace design and construction. National Airoil Burner Co., Inc.

PUMPS, COMPRESSORS

217 Controlled Volume Pumps — Bulletin 953, 24-pp, describes and illustrates use of controlled volume pumps in industrial water treating systems. Construction and operation features are described, capacity-pressure ranges and speed and stroke length adjustments are charted. Typical chemical feed and water treating systems are presented through text and diagrams; and an analysis of boiler water treating systems, cooling water treating problems, and systems for waste and sanitary water treatment included. Milton Roy Co.

218 Boiler Feed Pump — Bulletin 08B7899, 16-pp, describes design features and principal advantages of company's barrel type boiler feed pumps. Shows why balanced thrust design gives radial and axial balance for greatest reliability and for smooth operation and longer pump life. Allis-Chalmers Mfg. Co.

219 Horizontal Compressors — Bulletin L-640-B1C, 24 pp. presents single-stage horizontal compressors from 50 to 2000 cfm and from 10 to 150 psi. Gives information on basic specifications, standard equipment, capacity control, cylinder construction, other factors. A diagram of a complete installation is included along with cutaway views of major components and accessories. Worthington Corp.

LUBRICATION

220 Turbine Lubrication — The special problems of turbine lubrication are discussed in 8-pp Bulletin TU-1. Tells how purifiers keep power units in service; discusses inhibited and uninhibited oils, company's process for reducing sludge formation within lubrication system. Illustrated with diagrams of typical installations. DeLaval Separator Co.

221 Bearing Lubrication — Vol. XL, No. 10 of this company's Lubrication magazine provides an excellent 12-pp article on industrial bearing lubrication. Illustrated with photos and drawings, text covers such subjects as bearing design; bearing surfaces; bearing overhaul; aspects of lubrication, including factors involved in choice of turbine oils and diesel lubricants, and the deleterious effects of moisture; and the life expectancy of bearing lubricants. The Texas Co.

222 Lithium Soap Greases — This product information bulletin details qualities and specifications of company's multi-purpose lithium soap industrial greases. Advantages of multi-purpose grease use — such as prevention of lubricant misapplication, simplified maintenance procedures discussed, together with performance characteristics. Sinclair Refining Co.

223 Versatile Industrial Oil — Described in 20-pp Form AD 4078 is an all-purpose oil offering protection for a wide range of industrial equipment, and available in 15 viscosity grades. Discusses six major characteristics of the oil; explains and pictures its use in hydraulic systems, speed reducers, air compressors, electric motors, hydraulic turbines, bearing systems, etc. A chart shows grades available, their uses and physical properties. Standard Oil Co. (Ind.)

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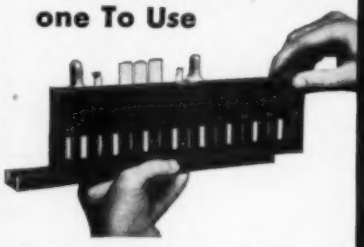

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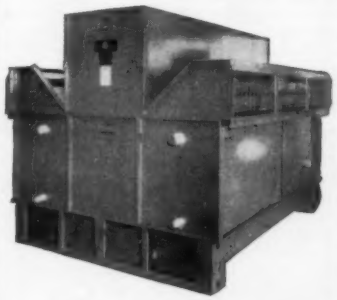

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WATER CONDITIONING

224 Handbook on Demineralizing — Comprehensive 40-pp Bulletin 5800-B compares various methods of water treatment, indicating the comparison between demineralizers and evaporators. It discusses the characteristics of the various types of available cation and anion exchange materials and offers data on operating costs of demineralizing. It tells when to use 2-bed, 3-bed, 4-bed, mixed or mono-bed demineralizers. It also indicates when decarbonators or vacuum deaerators should be installed. Cochrane Corp.

225 Water Treatment — Bulletin 5000, 24 pp, explains the reasons for boiler water treatment and tells services offered by company in providing formulations for individual plant requirements. Covers pre-treatment, internal treatment, treatment application, blow-down adjustment, test control. Dearborn Chemical Co.

226 Water Conditioning Data Book — An excellent reference volume, Data Book 2478A contains 108 pp and presents a compilation of 78 chapters and tables. Subjects covered include hydraulics; impurities in water; chemical conversions; coagulant, acid and alkali dosages; chemicals used in water treatment; water treatment processes; boiler feed make-up requirements; alkalinity relationships; specific gravities; chemical reactions. Available to qualified power engineers, please state your job title when requesting this. The Permutit Co.

227 pH and Chlorine Control — The 12th edition of company's handbook "Modern pH and Chlorine Control," 100-pp, incorporating theory and practice of colorimetric analysis, serves as a reference for quantitative determination of pH, chlorine, phosphate, nitrite, sulfate, hardness and other tests. Slide comparators and complete test kits are illustrated. In addition to standard pH determinations, methods are outlined for quantitative analyses of phosphate, calcium, magnesium, silica nitrate hardness in feedwater. Available to qualified power engineers. W. A. Taylor Co.

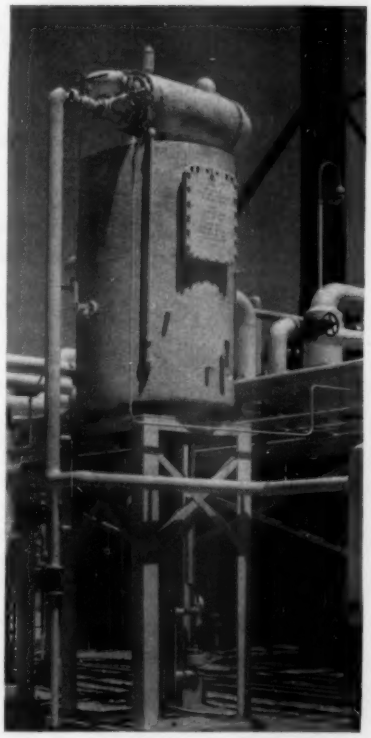
228 Feedwater Treatment — Process Bulletin B1, "Treatment of Boiler Feedwater by Direct, or Internal Method," discusses advantages of direct treatment, as a complete treating program or as a supplement to external systems. Explains why direct treatment is convenient, economical and complete, and points out how it improves steam quality and reduces boiler maintenance costs and downtime. National Aluminate Corp.

VALVES, TRAPS, PIPING AND ACCESSORIES

229 Check Valves — Twenty-pp Catalog 30 presents company's line of tilting-disc check valves made in iron, bronze and steel for working pressures to 3000 psi. Explains operating principles of tilting disc construction, discusses closing without slam, reduced loss of head, other advantages. Includes construction details, sizes. The Chapman Valve Mfg. Co.

230 Lubricated Plug Valves — Catalog PV-24, 36-pp, shows in detail a line of iron and steel lubricated plug valves. Many illustrations of the single, screwed and bolted gland type valves are shown, including photos, sectional and detailed drawings. Also included is physical data on dimensions. The Wm. Powell Co.

How to solve a feed water problem



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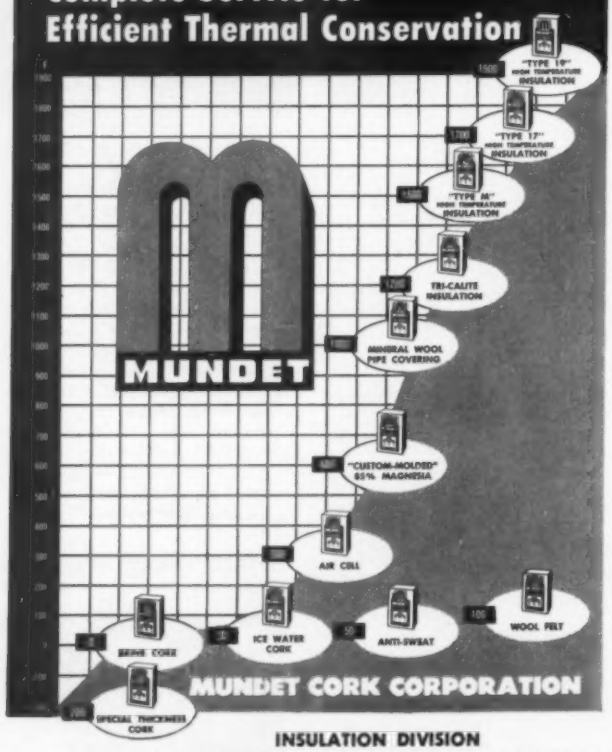

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231 **Valve Chart** — Form 194, 24 pp, is a valve comparison chart, listing valve figure numbers of 15 major manufacturers and the OIC equivalent valve figure numbers. Compares variety of valves in ferrous and non-ferrous materials, describes different valve lines. The Ohio Injector Co.

232 **General Purpose Valves** — Supplement No. 1 to Catalog F-9, 32-pp, offers complete information on company's series of general purpose drop forged steel valves, gate, globe and angle types, sizes ¼ through 2 in. Includes descriptions of each type along with drawings showing component parts. Dimensions and other specifications are tabulated, and a pressure-temperature ratings table is included. Henry Vogt Machine Co.

233 **Valve Charts** — Now available to power engineers are three well-organized wall charts on valve types, selection and protection. "How to know valves" covers four main types of valves from the standpoints of their appearance, inside construction, service intended, operation and use. "How to select valves" discusses five major factors involved in the choice of a valve — fluid, temperature, pressure, size and function. "How to protect valves" — written in "do and don't" style covers 11 important points in valve installation, operation and maintenance. R-P & C Valve Div., American Chain & Cable Co., Inc.

234 **Regulating Valves** — Bulletin 5305 describes double seated diaphragm regulating valves for use with control instruments, outlining special features of the valves, particularly the "flow line" contoured-body engineered for high capacity at low pressure drop. Leslie Co.

235 **Pump Valves** — Key features of company's line of pump valves are outlined in 6-pp Bulletin V-112. Includes cutaway view showing design features, standard materials table, and a table of standard valve sizes. Sims Pump Valve Co., Inc.

236 **Choosing the Right Valve** — Presenting valve selection as a matter of matching the valve's service characteristics with service requirements of the job, this practical 20-pp booklet explains and illustrates basic design features of gate, globe and check valves. It tells, in non-technical language, how each of these valve types works, and where it is suited for use. Disc, stem connection, bonnet and bonnet-joint characteristics are discussed. Crane Co.

237 **Industrial Valves** — Condensed Catalog 105, 28-pp, contains data on valves for a wide variety of applications. Includes dimensions and illustrations describing non-return (stop-check) valves, globe and angle stop valves, pressure seal design, angle univalves and small size globe valves designed for chain or extension operation in vertical lines, Also included is company's Mudwonder valve for abrasive fluids. Edward Valves, Inc.

238 **Boiler Blow-Off Valves** — Bulletin E-125, 24 pp, describes and illustrates the design and construction of company's quick-operating valves, angle valves, Y valves and duplex units specifically designed for boiler blow-off service. Includes dimensions. Everlasting Valve Co.

239 **Steel Gate Valves** — Four types of Hancock general purpose steel gate valves for process and power piping systems are described in illustrated Bulletin 202 C, 12 pp. Material specifications, di-

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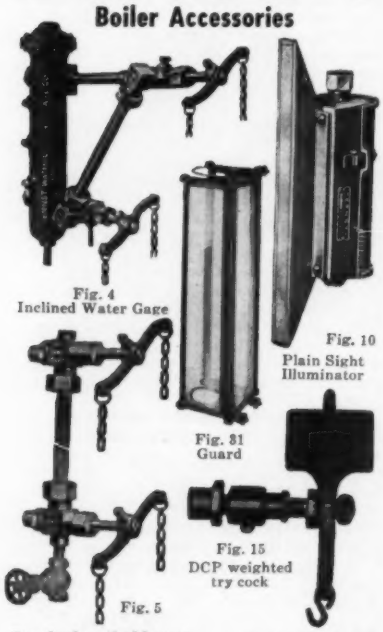

Fig. 4 Inclined Water Gage

Fig. 10 Plain Sight Illuminator

Fig. 31 Guard

Fig. 15 DCP weighted try cock

Fig. 5

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mensions given, also service pressure ratings. Manning, Maxwell & Moore, Inc.

240 Butterfly Valves — Construction details, engineering and application data on butterfly valves are provided in three illustrated bulletins. Eight-pp Bulletin 557 covers those of standard heavy-duty construction; Bulletin 558, 8 pp, those of standard medium-duty construction; and Bulletin 559, rubber-lined butterfly valves. W. S. Rockwell Co.

241 Steam Trap Selector — Twelve-pp Bulletin T-9 is designed specifically to aid in selection and application of steam traps on chemical processing equipment. Features a foldout piping diagram for 22 pieces of typical processing equipment — each showing recommended steam trap and piping arrangements. Also contains selector tables. Yarnall-Waring Co.

242 Steam Trap Book — Catalog J, 44 pp, serves as a manual of trapping practice. Includes a catalog section giving physical data and prices on cast semi-steel and forged steel inverted bucket steam traps, compound steam traps and ball float air and air relief traps; a handbook section explaining how to calculate condensate loads and select traps for all classes of equipment; a maintenance section explaining trap installation, trouble-shooting and repair. Armstrong Machine Works.

243 Expansion Joint Guide — Catalog 153, 24-pp, a complete design guide for application and selection of expansion joints, is filled with engineering data necessary to solution of pipeline expansion problems. Includes a discussion of types of expansion joints available and types of pipeline motion solved by expansion joints. Includes a schematic piping layout illustrating expansion joint applications and principles, as well as full specifications. Flexonics Corp.

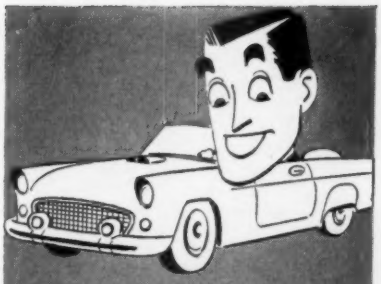
244 Flexible Ball Joint — Catalog 215-B, 20-pp, describes advantages of company's flexible ball joints for use in piping for power, process, heating, chemical, construction, or hydraulic service. Includes engineering specifications and data on the standard 300 lb series and the series 600. Screwed, flanged and welding end joints are listed, as are insulating joints and jacketed joints for handling asphalt and other liquids that solidify unless heated. Barco Mfg. Co.

REFRACTORIES, INSULATIONS

245 Refractory Notes — Included in Vol. XV of this company's Thermogram is an illustrated article on a method for decreasing hot topping costs in steel mills with minimum capital expenditure. Another story tells how bonded brick assemblies cut installation time in a coke plant. Refractory & Insulation Corp.

246 Refractory Concrete — Basic information on recommended practice for mixing and placing refractory concrete, used in the metal, power, ceramic, and petroleum refining industry as a material to withstand service temp to 2600 F or more, is presented in this 16-pp manual. Sections are devoted to special properties of refractory concrete, aggregates, refractory insulating concrete, and structural design. Universal Atlas Cement Co.

247 Insulations, Refractories — This 20-pp catalog features thermal insulations and refractories for general industrial applications. Organized for quick refer-



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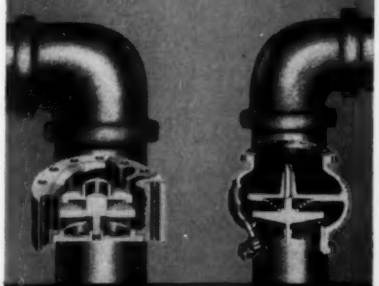

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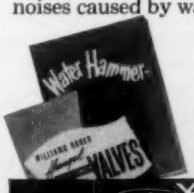

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ence, catalog provides information on composition, physical and thermal properties and sizes of the various products. Lists chief advantages, covers materials for efficient control of temperatures from – 400 F to 3000 F. Johns-Manville.

INSTRUMENTS AND CONTROLS

248 Metering and Control Equipment — Sixteen-pp Bulletin 18 is a comprehensive catalog offering information on company's meters, control equipment and engineering services. It is written for engineers in power plants, public utilities and process plants. Fifteen measured variables common to power and process operations form the index for selecting appropriate equipment. Bailey Meter Co.

249 Instruments, Controls — Condensed Catalog 1537 offers brief application information on manufacturer's line of instruments. Fully illustrated, covers draft and pressure instruments, flow meters, liquid levels and pressure gages, CO meters, pneumatic transmitters, positioning operators, temperature instruments, boiler feedwater controls, others. Includes references to detailed literature on each type of equipment. Republic Flow Meters Co.

250 Resistance Temperature Detectors — In 8-pp Publication 3016D are described a line of remote temperature-sensitive elements for use in indicating, recording, controlling and monitoring equipment. Operation, application and construction details of the resistance temperature detectors are presented, along with specifications and ordering tips. Instrument Div., Thomas A. Edison, Inc.

251 Boiler Feed Control — Bulletin 1003, a 12-pp catalog on boiler feed regulators, is illustrated with large application photos and detailed schematic drawings and charts. Relay and direct operation are covered. Case studies of representative boiler loads are presented to show stability of the Flowmatics in controlling feedwater automatically. Copes-Vulcan Div., Blaw-Knox Co.

252 Indicating Flow Meter — Bulletin 18-A, 22-pp, discusses advantages, construction and operation of company's Type H indicating flow meter. Presents technical data on the principles and theory of fluid measurement and discusses orifice type meters and orifice meter principles. Offers examples of flow rate calculations. Schematic drawings and diagrams, tabulated technical data and specifications are included. The Meriam Instrument Co.

253 D-C Amplifier — Twelve-pp Bulletin MSP 111.1 provides pictorial diagrams and descriptive information on company's PowrAmp Model P, an electronic low-voltage linear amplifier designed to increase the speed and accuracy of low level d-c voltage measurements. Discusses performance and construction features of the amplifier, and describes some applications. Specifications and ordering suggestions given. Hagan Corp.

254 Bi-Color Gage — Bulletin 1174 gives advantages of company's Multi-Port bi-color gage made for boiler operating pressures to 3000 psi. Points out chief design features, illustrates construction details through photos and drawings. Installation methods are also treated. Diamond Power Specialty Corp.

255 Sampling System — A newly developed system for continuous sampling and oxygen measurement of combustion processes is described in Bulletin 703. Points out advantages of system and diagrams component parts. Selection of sampling tube and gas selector units is discussed. Arnold O. Beckman, Inc.

ELECTRICAL EQUIPMENT

256 Motor-Generator Reference Book — Publication 51R7933 is a 50-pp booklet compiled to assist in the selection of motive power to handle most industrial applications. Neither textbook nor ordering catalog, this book provides a brief outline of the various types of motors, generators and motor-generator sets, telling their applications and operating requirements. Booklet is generously illustrated and includes performance data, ratings, as well as detailed information on speed control. Allis-Chalmers Mfg. Co.

257 Plug-In Busway — Twenty-pp Bulletin GEA-6470 describes the factory-assembled Flex-A-Power plug-in busway system permitting direct connection to bus bars for feeding lighting and power loads in industrial plants and public buildings. Describes in detail the construction and application of this busway system. Also lists ratings, weights, dimensions, installation data and guide form specifications. General Electric Co.

258 Testing Instruments — Bulletin 19-56, 16-pp, features company's electrical testing instruments, including ohmmeters, ground testers, dielectric test sets, motor rotation tester, cable fault locating

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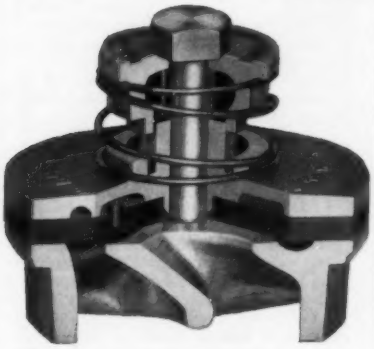

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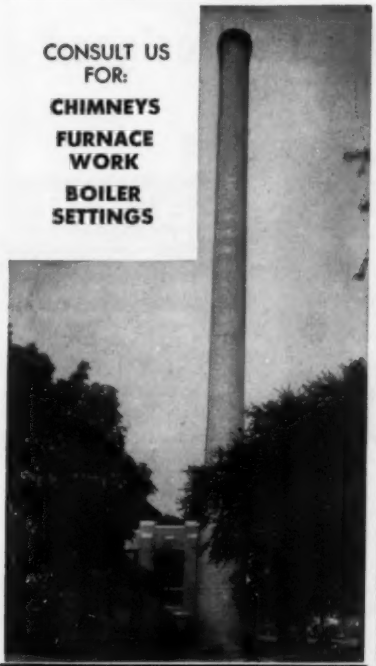

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equipment, transformer turn ratio test sets, corena test equipment, frequency meters, tachometers, others. Includes photos and descriptions of each type, including chief features, operating ranges, and applications. James G. Biddle Co.

259 **High-Capacity Fuses** — Form HCS, 6 pp, describes fuses of unlimited interrupting capacity on voltages to 600, designed to afford protection for loads of 600 to 5000 amp. Includes test data, charts on opening time, current limiting effect. Bussmann Mfg. Co.

260 **High-Power Batteries** — Bulletin CP-538/55 covers company's line of Hi-Power batteries for use in the control, switchgear, emergency lighting and auxiliary power fields. Includes data on battery ratings and capacities, details of design and construction, dimensions, weights and types of containers. C & D Batteries, Inc.

COAL, ASH HANDLING

261 **Fly Ash Collection** — The successful and economical separation of fly ash from boiler flue gases is discussed in 28-pp Catalog G405. Explains need for collection equipment and gives physical characteristics of fly ash. Describes company's Multiclone equipment as to principle of operation, performance and advantages. Western Precipitation Corp.

Postage-free cards for ordering catalogs are on page 113. You may also use the cards to order literature mentioned in the ads.

262 **Tractor Shovel** — The engineering, design and production stories of company's HD-11G tractor shovel are pictorially presented in 8-pp Catalog MS-460. Includes specifications and describes various features which mean easier servicing for less time-down and greater operator comfort. Allis-Chalmers Mfg. Co.

263 **Spreader Stoker** — Sixteen-pp Bulletin 800 describes manufacturer's Type C-C RotoStoker, a relatively small spreader stoker offering continuous cleaning and ash discharge advantages of larger units, without need of a basement for ash-removal. Explains this and other operational advantages of the stoker, which is adapted to modern steam boilers with output capacities of about 5000 to 75,000 lbs of steam per hour. Detroit Stoker Co.

264 **Coal Crusher** — Company's WC and WS series reolling ring coal crushers are described in Bulletin 154. Emphasizes special construction elements that mean greater coal reduction at lower operating costs. Cross section illustration shows both feeding and crushing action incorporated and tables give capacities, speeds, and dimensions. American Pulverizer Co.

OTHER EQUIPMENT

265 **Steam Condensers** — Some recent additions to this company's power plant condenser installations are pictured and described briefly in this 24-pp booklet. Also included are an engineering section on condenser design factors, and sections devoted to air removal equipment, to

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steam condenser specialties, and to maintenance services available. Condenser Service & Engineering Co., Inc.

266 On Cooling Tower Wood — The protection of cooling tower wood is the subject of Technical Paper 130. Explains how chemical and bacteriological attack can be controlled by acid treatment and wood preservatives to kill fungi. W. H. & L. D. Betz.

267 Steam Turbines — The advantages of company's solid wheel turbines, axial flow turbines, single stage and multistage, are outlined in illustrated Bulletin S-140. Describes various models in their line and includes application photos. The Terry Steam Turbine Co.

268 Technical Refrigeration — Twelve-pp Bulletin 754 covers a complete line of environmental testing and processing equipment. Provides illustrations and specifications on recently redesigned altitude, humidity, low temperature and prefabricated test chambers as well as specialized testing equipment. Includes helpful engineering data. Bowser, Inc.

269 Corrosion, Abrasion Control — Modern practices and products for the positive protection of metal equipment from the effects of corrosion and abrasion are described in this 16-pp bulletin. Covers factory and field application of rubber or synthetic linings to metal parts or products, and maintenance coatings available for application by plant personnel. Goodall Rubber Co.

270 Petroleum Pitch — This illustrated article on petroleum pitch as a boiler fuel stresses its low cost, other advantages. Explains combustion of pitch; discusses unloading method, burning, storage, fuel oil treatment, also precautions in handling hot pitch. Kor Corp.

271 After Cooler — Bulletin 130, 8-pp, explains the functions of company's Aero after cooler in removing moisture from compressed air and gas. The apparatus is described and illustrated with diagrams and photos. Included also are diagrams and illustrations of applications in liquefaction systems. Niagara Blower Co.

272 Preheating Combustion Air — This well-illustrated 36-pp booklet explains fuel savings and increased performance made possible by using waste heat in flue gases to preheat incoming combustion air. Also covers increased boiler output, ability to use lower grade fuels, other advantages afforded. Booklet contrasts regenerative with recuperative preheaters; explains operating principle and structural details of the Ljungstrom air preheater. Applications for other than power boilers are also covered. Air Preheater Corp.

273 Data on Insulations — Insulation solutions for a wide range of temperature problems are charted in this folder. Provides brief descriptive information and tells forms available for high temperature applications, for intermediate temperature use, for hot and cold water and low pressure steam, for ice water and frigid temperatures. Mundet Cork Corp.

274 Turbine Speed Control — Thirty-pp wire-bound Bulletin H-21 is titled, "Fundamentals of Turbine Speed Control." It is an elaborately illustrated, educational booklet intended to clarify the operation of common types of automatic speed control for steam turbines. An introductory section covers general fundamentals of automatic control systems, and includes a key to control terminology. Simplified diagrams show operating principles of actual control systems. Elliott Co.

275 Pyrometers, Thermometers — Bulletin GEC-1324A describes features, accessories, application, specifications and special calibration of instruments for temperature indication and control of industrial processes. General Electric Co.

276 Fluid Drives — Bulletins 9419 and 9519 are an illustrated catalog and selection guide on company's new Type VS Class 2 Gyrol fluid drives. Catalog discusses advantages and applications of the drives, covering speed control, power savings, simplified installation, etc. A sectional view shows construction and principle of operation. Dimensions for six sizes of drives are provided. Selection guide consists of tables indicating proper drive to use. American Blower Corp.

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278 Oil and Gas Burners — Bulletin OB-53, 28 pp, gives principles of selection and application of oil or gas burners, or a combination of both for standard and wide capacity range operation, together with air registers and fuel oil heating and pumping sets. Conversion table shows approximate relationships between quantity of oil burned, boiler capacity and air required for combustion. The Engineer Co.

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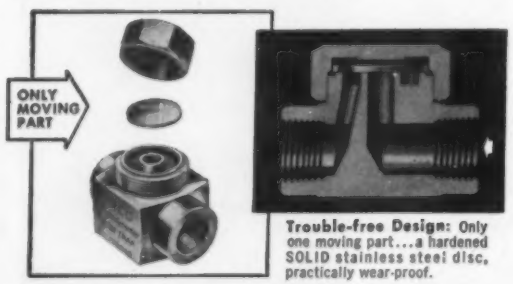

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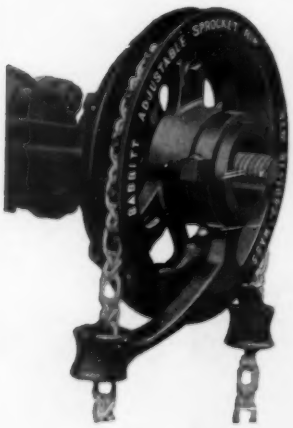

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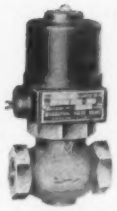

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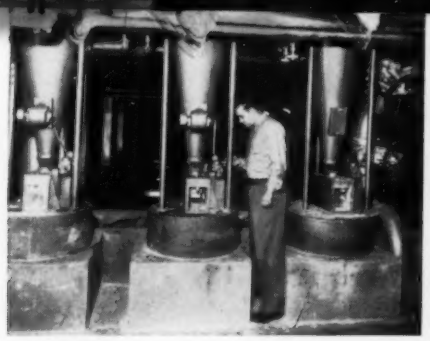
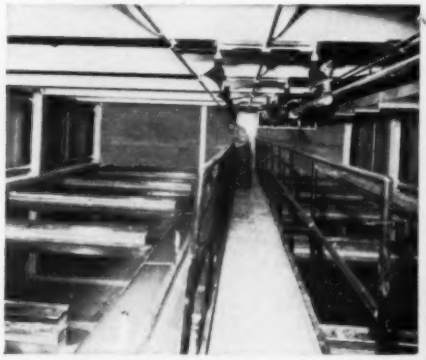
near Danville, Illinois, was designed by Sargent & Lundy. 75,000-kw Unit 1 went on the line in May 1955. 100,000-kw Unit 2 goes in service October 1956.



Chemical Feeders: 1st step in treating all water for plant use is accurate dosages of lime and alum for treatment in Precipitator.

1800 gpm Precipitator clarifies and softens cold river water. Dealkalizes, too—eliminating need for degasifier in demineralization.



ILLINOIS POWER EXPANDS AGAIN!

Latest 175,000-kw station is protected by Permutit-conditioned water

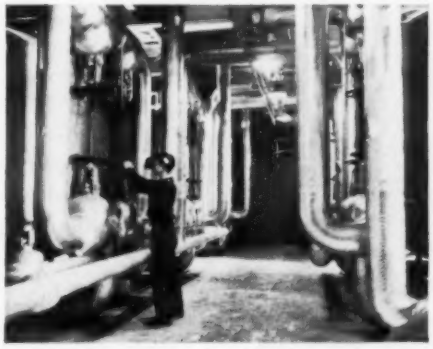
To meet rapidly growing needs, progressive Illinois Power Company has built two high-pressure stations within two years.

75,000-kw Hennepin Station went on the line in 1954. Its 1450 psig boiler requires *feedwater of the highest quality.* To produce this makeup, Permutit Demineralizers were installed.

When Illinois Power built the new Vermilion Station, Permutit water conditioning was installed again. To protect its turbine and boiler, all makeup is demineralized by the Permutit ion exchangers shown.

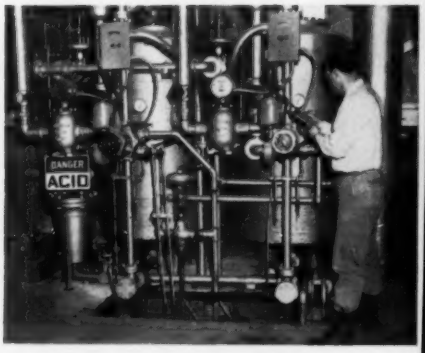
For Vermilion's big cooling-tower system, a different grade of water is most economical. The Permutit Precipitator and Filters shown produce it.

You can get this complete protection for your plant. We'll gladly help. Write outlining your problem. The Permutit Company, Dept. PE7, 330 West 42nd Street, New York 36, N. Y. Permutit Co. of Canada, Ltd., 207 Queen's Quay, Toronto 1, Ont.



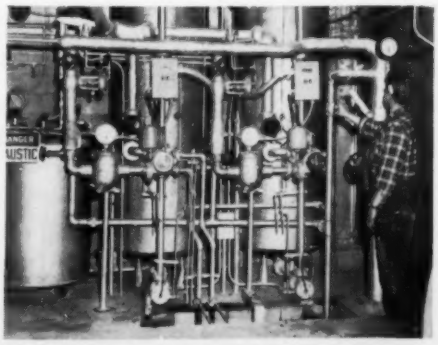
Pressure Filters further clarify Precipitator effluent . . . deliver finished water to protect Vermilion Station's 53,000 gpm cooling-tower system.

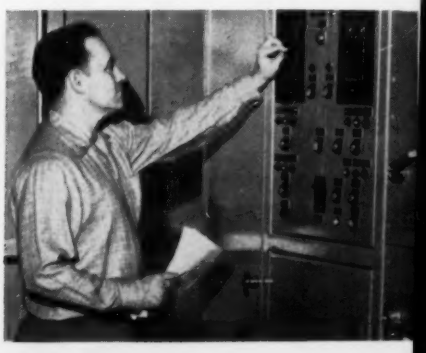
Anion Exchangers: Permutit S resin removes the few remaining minerals . . . protects Vermilion Station's turbine from troublesome silica deposits.



Cation Exchangers: Permutit Q resin removes metallic cations from Precipitator effluent to prevent boiler scale . . . allow high heat-transfer rates.

Control Cubicle operates demineralizers. Determines end-point, then sequences backwashing, regeneration, rinsing, return to service. Even prepares regenerant charges.





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